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CASE REPORT

Novel procedure for hepatic venous outflow block after liver resection: A case report

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Abstract

BACKGROUND

Postoperative complications like remnant hepatic vein (HV) outflow block and liver torsion can occur after right hepatectomy. Hepatic falciform ligament fixation is typically used to prevent liver torsion. We report a novel procedure to manage outflow block.

CASE SUMMARY

An 80-year-old man developed HV outflow block after remnant right hepatectomy, despite liver fixation and intraoperative HV flow check. He had a history of cholangiocellular carcinoma and had undergone posterior segmentectomy and choledojejunostomy. The falciform ligament fixation was inadequate to maintain liver position. Emergency surgery was performed, using an omental flap and mobilized right side colon with ileocecal region to prevent liver dislocation due to intraabdominal adhesion. His postoperative course was uneventful.

CONCLUSION

This is the first report providing a novel surgical procedure when the falciform ligament is insufficient for remnant liver fixation.

Key Words: Hepatectomy; Postoperative complications; Budd-Chiari syndrome; Hepatic vein outflow block; Emergency surgery; Case report

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Core Tip: This report presents a case of an 80-year-old man who developed hepatic vein outflow block post right hepatectomy. Despite standard falciform ligament fixation, the remnant liver dislocated due to intraabdominal adhesion. An emergency operation using an omental flap and mobilized right side colon successfully managed the outflow block. This novel procedure provides a solution when the falciform ligament is insufficient for liver fixation.

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INTRODUCTION

In radical hepatectomy for malignant hepatic disease, it is important to balance between safety and logically negative margin (R0) resection to prevent impaired hepatic reserve. Recently, various methods have been developed to expand safety margins of hepatectomy, such as percutaneous transhepatic portal embolization (PTPE)[1], associating liver partition, and portal vein (PV) embolization for staged hepatectomy[2]. These procedures make it possible for an effective radical hepatectomy with caudate lobe resection. Remnant hepatic vein (HV) outflow block after right hepatectomy has been reported as one of the most rare postoperative complications, and various managements and precautionary procedures have been reported[3-6]. Not only HV outflow block but also hepatic venous outflow obstruction of the inferior vena cava (IVC) or the PV were reported as complications related to remnant liver torsion[7-9]. Based on these reports, fixation of the hepatic falciform ligament to the anterior abdominal wall after right hepatectomy is regarded as the gold standard for remnant liver torsion. However, fixation may become insufficient in patients who have had the caudate lobe removed, particularly those with the paracaval portion and Spiegel lobe, or who have experienced multiple postoperative complications including intra-abdominal adhesions. Here we report a case of managing outflow block with a novel procedure using not only the pedicled omental flap but also the mobilized right side colon with ileocecal region.

CASE PRESENTATION

Chief complaints

Cholangiocellular carcinoma of mixed hepatocellular carcinoma.

History of present illness

An 80-year-old man with a large cholangiocellular carcinoma of mixed hepatocellular carcinoma of 6 cm × 10 cm at segments VIII and I was referred to our institute. The carcinoma was suspected of invading the middle HV (MHV), right HV (RHV), and IVC (Figure 1A and B). Eighteen years ago, due to cholangiocellular carcinoma, he has undergone posterior segmentectomy without RHV resection, extrahepatic bile duct resection, and choledochojejunostomy.

Four weeks after PTPE of the right PV, a remnant right hepatectomy with caudate lobe resection was performed. Intraabdominal adhesions were severe, and adhesiolysis around the liver was performed carefully (Figure 1C and D). The anterior branch of the Glisson and all branches of the caudate lobe were ligated and resected. Thereafter, choledochojejunostomy was left untouched and preserved. After complete transection of the liver, the MHV was transected. Since IVC was invaded by the carcinoma, excision of the partial IVC combined with RHV was performed. However, IVC was closed with sutures. The remnant liver was connected to the IVC only by the left HV (LHV) due to the removal of the Spiegel lobe, and the LHV had an unstable neck of about 15 mm. The scarring falciform ligament and the liver parenchyma were fixed to the left side of anterior abdominal wall as much as possible to prevent the LHV kinking and outflow block. There was no sign of HV stenosis or outflow block on ultrasonography (US) before the abdominal wall closure (Figure 1E). The total operation time was 657 minutes and the amount of blood loss was 530 mL without transfusion.

After going back to the intensive care unit, US revealed a regurgitation of umbilical portion (UP), disappearance of triphasic wave and poor blood flow of the LHV.

History of past illness

Eighteen years ago, due to cholangiocellular carcinoma, he has undergone posterior segmentectomy without RHV resection, extrahepatic bile duct resection, and choledochojejunostomy.

Personal and family history

None.

Physical examination

No particular abnormalities were observed in the physical examination.





Figure 1 Preoperative and the first operation information of this case. A: Contrast enhanced computed tomography of tumor. Arrowhead indicates suspicious of tumor invasion for middle hepatic vein and inferior vena cava; B: Schema of this case; C: Intraoperative photography after adhesiolysis around the liver; D: Intraoperative photography after specimen is removed. Arrowhead indicates extrahepatic naked left hepatic vein; E: Doppler ultrasonography shows normal hepatic vein flow direction. MHV: Middle hepatic vein; IVC: Inferior vena cava; RHV: Right hepatic vein; UP: Umbilical portion, LHA: Left hepatic artery; Pant: Anterior branch of portal vein.

Laboratory examinations

Sustainable increase of aspartate aminotransferase and alanine aminotransferase were observed every 3 hours in blood tests after operation (Figure 2A).

Imaging examinations

Eighteen hours after the first operation, a contrasted computed tomography (CT) scan revealed remnant liver congestion, and LHV outflow block was suspected (Figure 2B).

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Figure 2 Postoperative course and information, and second operation of this case. A: Postoperative blood test of this case; B: Contrast enhanced computed tomography (CT) scan of 18 hours after the first operation. Contrast enhancement of segment 4 is heterogeneously, and the root of left hepatic artery is kinking (arrowhead); C: Intraoperative photography of the secondary operation. Arrowhead indicates mobilized ileocecal region and omental flap; D: Contrast enhanced CT scan of 11 days after the second operation. Remnant liver was repositioned and parenchymal contrast enhancement was improved; E: Postoperative course after secondary operation. AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; ICU: Intensive care.

FINAL DIAGNOSIS

Remnant liver congestion, and LHV outflow block.

TREATMENT

An emergency operation was performed. When the abdominal wall was re-opened, the remnant liver was located into the right subphrenic space due to the combination of remnant liver hypertrophy by PTPE and the compression of the abdominal wall. Although the fixation of the falciform ligament was remained, it did not keep the remnant liver to the appropriate position. After lifting up the remnant liver and shift it to the left side of the abdominal cavity, the LHV flow was immediately improved. The doppler-US also detected the triphasic wave of the LHV. However, once the remnant

Table 1 Re	norted cases of h	enatic vein outflow block after liver resecti	on
Table Tite	pulleu cases ul li	epatic vein outnow block after inver resection	

Ref.	Age/Sex	Primary disease	Operative procedure	Middle hepatic vein resection	Time to intervension	Treatment procedure	Outcome
Pitre <i>et al</i> [3]	75/M	HCC	RH	Yes	7 days	Fixation of renmant liver	Dead
Pitre <i>et al</i> [3]	55/M	Colorectal liver metastasis	RH with partial resection of left lobe	Uncertain	Urgent	Fixation of renmant liver	Alive
Poon <i>et al</i> [4]	37/M	HCC	Right trisegmentectomy	Yes	Intraoperative	Fixation of renmant liver	Alive
Benesch et al[<mark>5</mark>]	15/M	HCC	Right trisegmentectomy with total sement I resection	Yes	13 days	Expandable metalic stent placement into left hepatic vein	Alive
Sato <i>et al</i> [<mark>6</mark>]	67/M	HCC	RH	No	24 hours	Fixation of renmant liver	Alive
Ogata et al[<mark>13</mark>]	Uncertain	Uncertain	RH	Uncertain	Uncertain	Uncertain	Dead
This case	80/M	HCC	RH with total segment I resection	Yes	21 hours	Filling in the right suphrenic space with omental flap and mobilized ileocecal region	Alive

HCC: Hepatocellular carcinoma; RH: Right hepatectomy.

liver located in spontaneous position, the root of LHV deformed like S-shaped, and LHV outflow block was replicable. As falciform ligament fixation was insufficient for keeping the remnant liver in its anatomical position, a pedicled omental flap was used to fill in the caudate lobe space, and ileocecal region was also mobilized to fill in the right subphrenic space (Figure 2C). The total operation time was 152 minutes and the amount of blood loss was 513 mL. Remnant liver was kept its anatomical position, and parenchymal contrast enhancement improvement was identified by CT scan at 11 days after the second operation (Figure 2D).

OUTCOME AND FOLLOW-UP

Postoperative course was uneventful, and he discharged at 17 days after the second operation (Figure 2E).

DISCUSSION

HV outflow block is recognized as one of the most critical complications after living donor liver transplantation and it sometimes leads to graft loss[10,11]. The incidence rate of this complication is reported 5%-13%[12], whereas HV outflow block following major hepatectomy occurred in 1 of 1078 patients (0.09%). Six cases of HV outflow block excluding IVC obstruction have been reported, and mortality reaches up to 33%[3-6]. All cases occurred after right lobe hepatectomy (Table 1), and emergency treatment within 24 hours of liver resection results in good prognosis. Fixation of the remnant liver to its anatomical position in an emergency surgery or placement of expandable metallic stent in angiography has been reported as a treatment of this complication. In addition, LHV outflow is decreased after right hepatectomy even though with the left triangular ligament or MHV is preserved, and the LHV flow is significantly improved when the remnant liver is fixed to its anatomical position[13]. It means that all right hepatectomy has a risk for remnant liver torsion without the left triangular ligament resection or extrahepatic length of the common trunk of the MHV and LHV. Based on this, the remnant liver fixation to its anatomical position is regarded as the gold standard for HV outflow block after right hepatectomy. However, this case is the first to prove that this gold standard was insufficient to prevent the remnant liver torsion.

To assess the risk of outflow block after right hepatectomy, two objective indexes are defined; UP-IVC distance, and UP-IVC angle. UP-IVC distance is the distance between the origin of UP and IVC, and UP-IVC angle is the angle between the vertical line and UP-IVC line which is extended UP-IVC distance. Our hypothesis is that UP-IVC distance reflects the absence of segment I, and UP-IVC angle reflects the rotation of the remnant liver (Figure 3A, B and C). Evaluating these indexes by intraoperative US examination may predict the risk of outflow block, however, further analysis is needed for it.

In this case, the falciform ligament had adequate strength to fix the remnant liver to its anatomical position even though the previous posterior segmentectomy. However, mobility of the hepatic flexure, transverse colon, and other organs may be insufficient to fill in the right subphrenic space due to intra-abdominal adhesions of post-choledochojejunostomy. Furthermore, the intra-abdominal adhesions of organs in upper left region may push the remnant liver into the





Figure 3 Contrast enhanced computed tomography scan comparison of umbilical portion-inferior vena cava distance and umbilical portion-inferior vena cava angle. A: Pre-operation; B: Post-operation of 1POD; C: 11POD. POD: Post operative day; IVC: Inferior vena cava; UP: Umbilical portion.

right subphrenic space. Omental flap is reported as a good candidate to fill in the caudate lobe space[9], and this case also suggested that mobilization of the right lower abdominal organ may be a precaution to fill in the right subphrenic space. In addition, a reduction in the length of extrahepatic LHV and a preservation as much of the liver parenchyma surrounding the LHV as possible may decrease the risk of HV kinking, if the oncological surgical resection margin is assured.

CONCLUSION

In conclusion, the remnant liver fixation with falciform ligament may be insufficient for post-major hepatectomy patients to maintain the remnant liver in its anatomical position and not only intraoperative but also bed-sided Doppler-US is crucial for an early detection of the HV outflow block. In case the HV outflow block is suspected, immediate treatment is vital for good prognosis, and if the right subphrenic space is not filled by the omental flap, small intestine, or transverse colon, mobilized ileocecal region may be a good candidate for filling it.

FOOTNOTES

Author contributions: Higashi H and Abe Y reviewed the literature, contributed to manuscript drafting, reviewed computed tomography scans, and selected the figures; Abe K, Nakano Y, Tanaka M, Hori S, Hasegawa Y, Kitago M, and Kitagawa Y reviewed the literature; Abe Y was responsible for the revision of the manuscript for important intellectual content; all authors issued final approval for the version to be submitted.

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