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Lesson of the Month

Extended left trisectionectomy severing all hepatic veins preserving segment 6 and inferior right hepatic vein

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Introduction

Involvement of all major hepatic veins is usually a contraindication to resection for advanced tumors of the liver. To overcome this surgical challenge some authors described several techniques of hepatic vein reconstruction.[1,2]

Inferior right hepatic vein is sometimes present and drain the posteroinferior area of the right liver (segment 6). In 1987, Makuuchi and co-workers proposed four types of hepatectomy for resection of the main right hepatic vein and preservation of the inferior right hepatic vein.[3] At that time they mentioned that extended left trisectionectomy, one of those four types, had not yet been performed. Ozeki et al.[4] performed an extended left trisectionectomy but the bulk of segment 7 was preserved because of the existence of thick middle right hepatic vein. Similar operation has been performed by Baer and co-workers,[5] also with preservation of part of segment 7.

We described a case of extended left trisectionectomy exactly as proposed by Makuuchi in 1987, which comprises left trisectionectomy[6–8] with resection of segments 7 and 1 by severing all major hepatic veins and preservation of the inferior hepatic vein. Remnant liver was represented by segment 6 alone. To our knowledge this is the first paper to report the extended left trisectionectomy, idealized by Makuuchi and co-workers 20 years ago.

Methods

Preoperative evaluation

A 53-year-old woman was admitted to our hospital with a hepatic mass detected by abdominal ultrasonography incidentally. CT scan was then performed and was consistent with cholangiocarcinoma. A complete screening including upper digestive endoscopy, colonoscopy, chest CT, and a positron emission tomography (PET) scan revealed no extrahepatic disease. Liver function test were all within normal range.

Assessment of the CT scan suggested that it would be possible to perform a left trisegmentectomy extended to segment 7 and caudate lobe; however, all major hepatic veins were involved by the tumor (Fig. 1A). The tumor involved left liver (segments 1–4) and right anterior pedicles (Fig. 1B). Fortunately, there was a thick inferior right hepatic vein that would be sufficient to provide outflow for remnant segment 6 (Fig. 1C). CT scan showed a voluminous segment 6 (Fig. 1D) and volumetry calculated the future remnant as 38% of the total liver volume, therefore precluding preoperative left portal vein embolization.

Operative assessment

Surgery indicated that the tumor was confined to the liver and right, middle and left hepatic veins were clearly involved by the tumor (Fig. 2A). Intraoperative ultrasound confirmed the presence of a large inferior right hepatic vein and complete involvement of all major hepatic veins. There was evident hypertrophy of segment 6 and congestion and discoloration of all other segments presumably caused by

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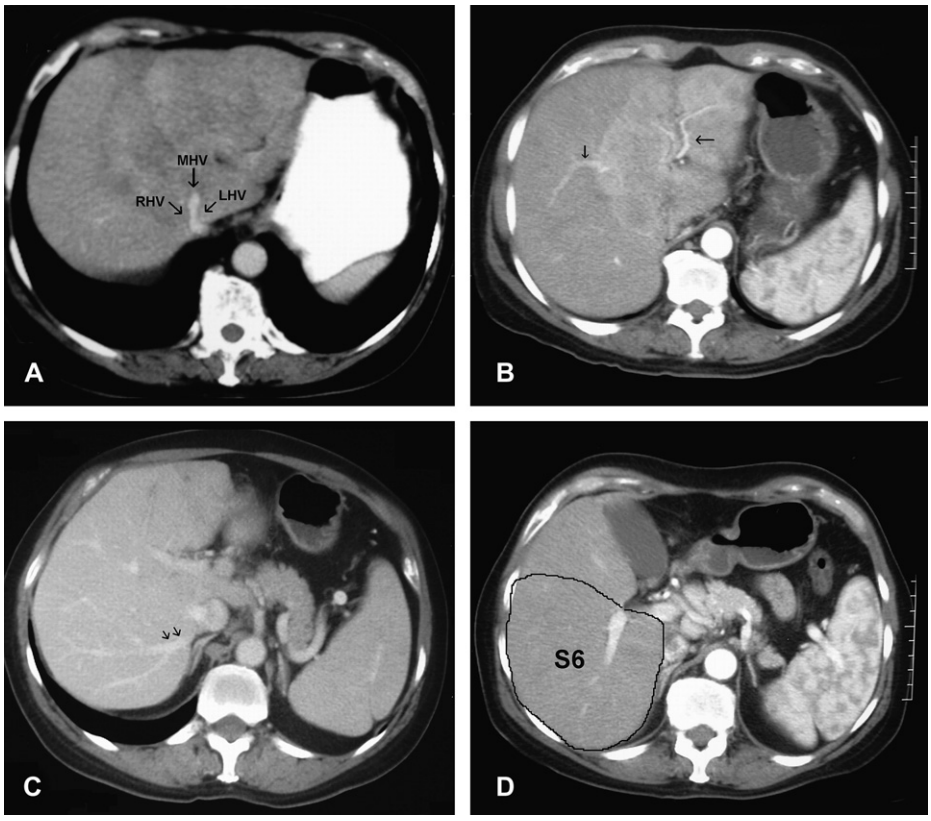

Figure 1. Preoperative computed tomography scan (A) involvement of all three major hepatic veins, (B) involvement of left and right anterior pedicles (arrows), (C) stout inferior right hepatic vein is present (arrows) and (D) segment 6 is hypertrophied and comprises 38% of total liver volume. RHV – right hepatic vein; MHV – middle hepatic vein; and LHV – left hepatic vein.

either venous outflow impairment and/or portal vein invasion. The line of future liver transection was clearly defined. The tumor involved left liver, right anterior segments and segment 7 (Fig. 2B).

Operative technique

A Makuuchi's extended left trisegmentectomy was performed using intrahepatic glissonian access as described elsewhere.[9] Mobilization of the right liver was limited to the minimum, and efforts were made to prevent damages to the inferior right hepatic vein. Left main pedicle and right anterior pedicles were ligated and divided. Left and middle hepatic veins were divided and closed during liver mobilization. Upper part of right liver was cautiously mobilized in order to encompass the main right hepatic vein outside liver substance. The right hepatic vein was then closed with a running suture. The liver parenchyma was transected by clamp-crushing and bipolar forceps using intermittent Pringle maneuver. Surgical specimen was then removed (Fig. 3). Total vascular exclusion was necessary during 11 min at the end of the procedure. Estimated blood loss was 600 ml, without transfusion. Patency of inferior right hepatic vein was evaluated by color-Doppler

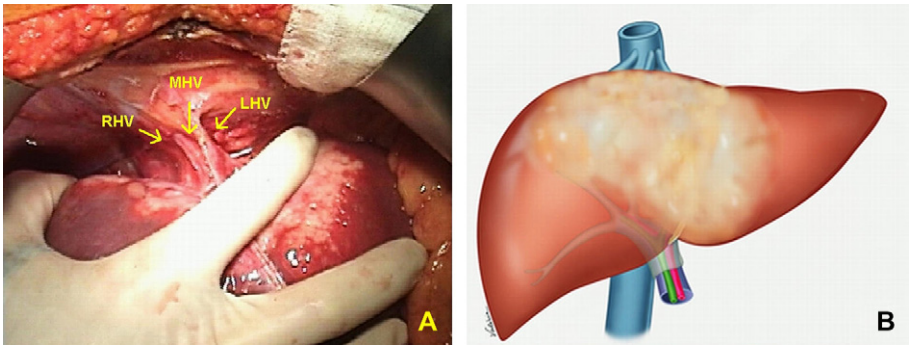

Figure 2. Intraoperative view (A) involvement of all three major hepatic veins and (B) schematic view of the tumor.

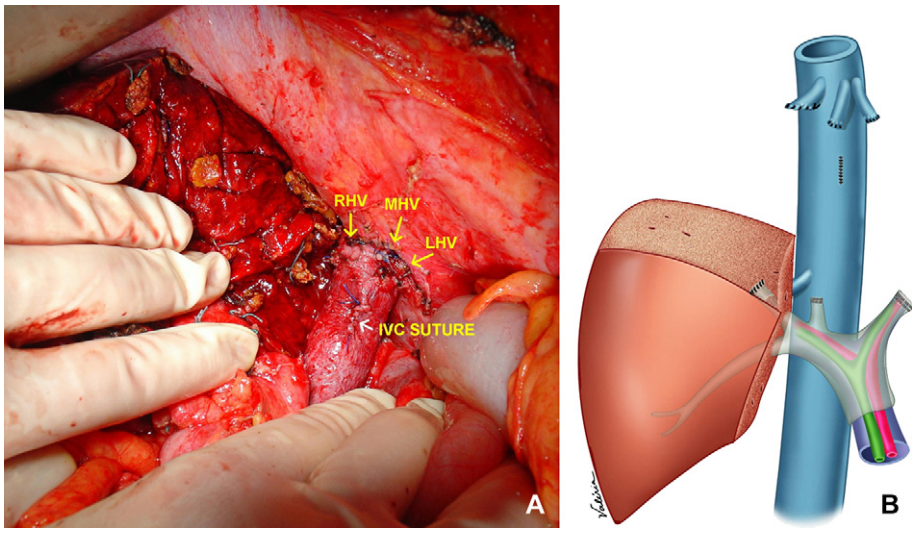

Figure 3. Extended left trisectionectomy (A) intraoperative view after severing of all three major hepatic veins (arrows) and partial inferior vena cava (IVC) resection (arrow) and (B) schematic view of the remnant liver. RHV – right hepatic vein; MHV – middle hepatic vein; and LHV – left hepatic vein.

intraoperative ultrasound and showed normal flow to inferior vena cava (Fig. 4).

Results

Outcome

Postoperatively, the patient exhibited no elevation in bilirubin (0.58 mg/dl), INR was kept within normal range (peak 1.4), lower hemoglobin was 10.3 and higher aminotransferase was 221 U/l. She was discharged on fifth postoperative day. Postoperative triphasic CT showed hypertrophy of segment 6 and a patent inferior right hepatic vein (Fig. 5). The patient had an uneventful postoperative course and was well without any sign of recurrence eight months after hepatectomy.

Discussion

Anatomic considerations

Among the accessory hepatic veins, the thickest one is the inferior right hepatic vein and is a significant vessel in 20–24% of the patients.[3] However, when all major veins

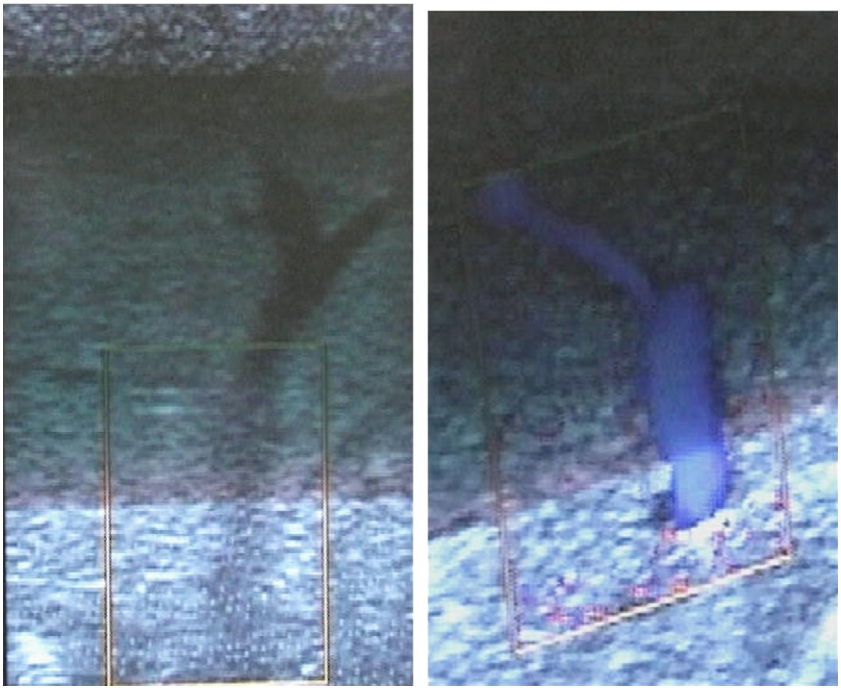

Figure 4. Intraoperative color-Doppler ultrasonography shows normal grade venous flow from inferior right hepatic vein.

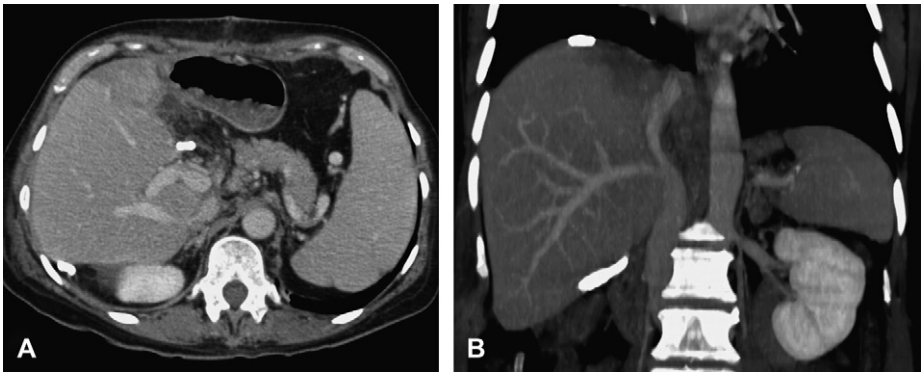

Figure 5. Postoperative computed tomography scan (A) hypertrophy of the remnant liver (segment 6) with patent inferior right hepatic vein and (B) sagittal view of the liver shows exclusive drainage of the remnant liver by inferior right hepatic vein.

are involved by the tumor the inferior right hepatic vein is usually enlarged and may be the unique drainage vein for the entire functioning liver. This may occur more often in slow-growing tumor such as intrahepatic cholangiocarcinoma. One way to induce inferior right hepatic vein enlargement is to perform right hepatic vein embolization preoperatively.[10]

Technical issues

The main tumor in this case is a giant cholangiocarcinoma extending from the left lobe to the caudate lobe, right anterior segments (segments 5 and 8) and the posterosuperior area of the liver (segment 7). Because complete involvement of the major hepatic veins is present it is generally said to be inoperative. However, no chronic liver disease was present and the inferior right hepatic vein was seen on preoperative CT scan. The volume of the future liver remnant was calculated as 38%. Therefore it was judged to be resectable. Interestingly, during the procedure the demarcation between segment 6 and the rest of the liver was clearly visible due to complete outflow impairment of other segments. During parenchymal transection we noted a marked increase in venous collaterals within the line of liver transection. Because of this finding, liver transection was performed under intermittent Pringle maneuver to minimize blood loss. At the end of the procedure the segment 6 was completely detached from the rest of the liver which was firmly adhered to the inferior vena cava. We then decided to perform total vascular exclusion in order to remove the surgical specimen that required additional partial resection and suture of the inferior vena cava which was accomplish in 11 min.

Makuuchi's extended left trisectionectomy was thought to be very difficult to perform because of the large amount of resected liver and small volume of remnant functional liver parenchyma. However, in the special situation that requires this type of operation, all major hepatic veins are already occluded resulting in natural enlargement of the inferior right hepatic vein. The portal branches for left liver were also obstructed resulting in compensatory hypertrophy of the segment 6. Indeed, almost all liver parenchyma excised was non-functional and postoperative liver function tests reflected this fact with very little disturbance.

In summary, we describe the feasibility of extended left trisectionectomy idealized by Makuuchi 20 years ago, which was successfully performed in one patient with a giant cholangiocarcinoma. This technique can be used safely in patients with involvement of all major hepatic veins where an inferior right hepatic vein is present and patent. Intraoperative ultrasound is essential for planning such procedure and preoperative volumetry can assure the surgeon that the future liver remnant will be enough avoiding postoperative liver failure.

Acknowledgment

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