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Graft harvest of right posterior segment for living-donor liver transplantation



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ABSTRACT

INTRODUCTION: Right posterior segmental graft (RPSG) is an alternative procedure for living-donor liver transplantation (LDLT). Although the first case of RPSG was reported in 2001, it has not been disseminated because of the lack of popularity, technical concerns, and surgical difficulties.

PRESENTATION OF CASE: A 37-year-old man with primary sclerosing cholangitis. His spouse was the only transplantation candidate, although she was ABO incompatible. Preoperative investigations revealed that left-lobe graft was insufficient for the recipient and that right-lobe graft was accompanied by donor risk. In RPSG, estimated graft-to-recipient weight ratio (GRWR) and estimated ratio of liver remnant were reasonable. In the donor operation, the right hepatic vein (RHV) and demarcation line were confirmed, and intraoperative cholangiography was performed. The cut line was carefully considered based on the demarcation line and RHV. The RPSG was harvested. Actual GRWR was 0.54. Unfortunately, this recipient showed a poor course and outcome after LDLT.

DISCUSSION: Segmental branches of vessels and biliary duct may be not suitable for reconstruction, and surgeons must exercise some ingenuity in the recipient operation. Segmental territory based on inflow and that based on outflow never overlap completely, even in the same segment. The selection of RPSG based only on liver volume may be unfeasible. Liver resection should be carefully considered based on preoperative imaging, and demarcation line and RHV during surgery.

CONCLUSION: RPSG is a useful tool for LDLT. However, detailed studies before surgery and careful consideration during surgery are important for RPSG harvest.

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1. Introduction

Living-donor liver transplantation (LDLT) is widely performed for end-stage liver diseases. Adult-to-adult LDLT is successfully performed, when appropriate preoperative evaluations, surgical procedures, and postoperative management techniques are established.¹ Graft volume is one of the key factors for both donor safety and recipient survival. In adult-to-adult LDLT, the size of the left-lobe graft is frequently insufficient, and the size of the right-lobe graft usually satisfies the liver volume. However, the donation of right-lobe graft has a higher risk to the donor than that of left-lobe graft.

Right posterior segmental graft (RPSG) has been introduced as an alternative graft procedure to increase safely the number of donor candidates.^{2,3} RPSG is a partial liver graft of Couinaud's segments 6 and 7 with the right hepatic vein (RHV). The first LDLT

procedure with an RPSG was reported in 2001.² However, RPSG has not been widely used because of the lack of popularity of RPSG and technical concerns.¹ Here, we report a case of an RPSG donor for adult LDLT. Preoperative evaluation and detailed surgical procedures are presented.

2. Case report

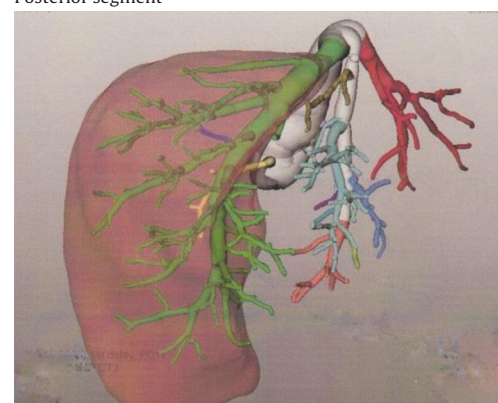
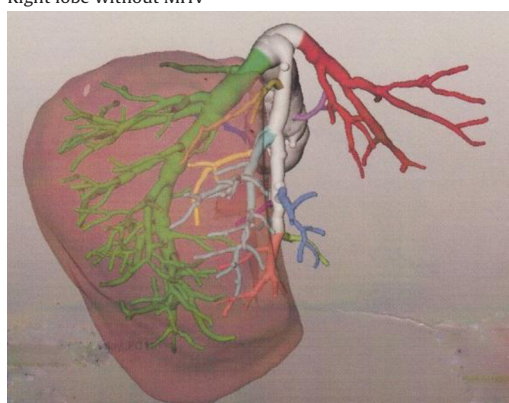
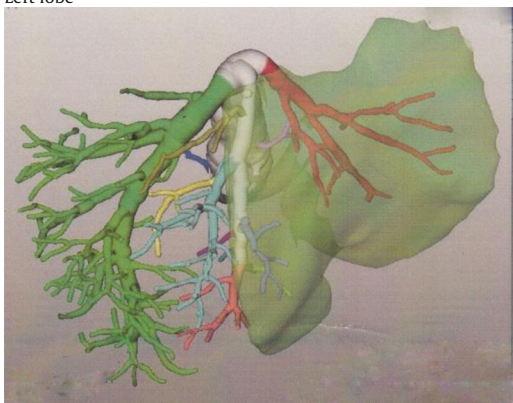
Here, we report a 37-year-old man with primary sclerosing cholangitis. Model for End-Stage Liver Disease score was 33 points, and he was registered in the LDLT program. His body weight was 72 kg. Donor candidates were limited in this case, and his 36-year-old spouse was the only candidate, although she was ABO incompatible. Preoperative investigation including volumetric computed tomography was performed. Segmental territories of portal and hepatic veins were also analyzed, and liver volume was calculated as measured liver volume (mL) × 0.91 (MeVis software; MeVisLab, Bremen, Germany). Estimated whole liver volume was 922 mL. Estimated graft volume, estimated ratio of liver remnant, and estimated graft-to-recipient weight ratio (GRWR) were evaluated in grafts with left lobe, right lobe without middle hepatic vein (MHV), and posterior segment (Table 1). In posterior segmental

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Table 1
Preoperative volumetric assessment of liver grafts.

Graft type	Left lobe	Right lobe without MHV	Posterior segment
Estimated graft volume (ml)	206	708	469
Estimated graft/whole liver	0.22	0.77	0.51
Estimated liver remnant/whole liver	0.78	0.23	0.49
Estimated GRWR	0.286	0.983	0.651



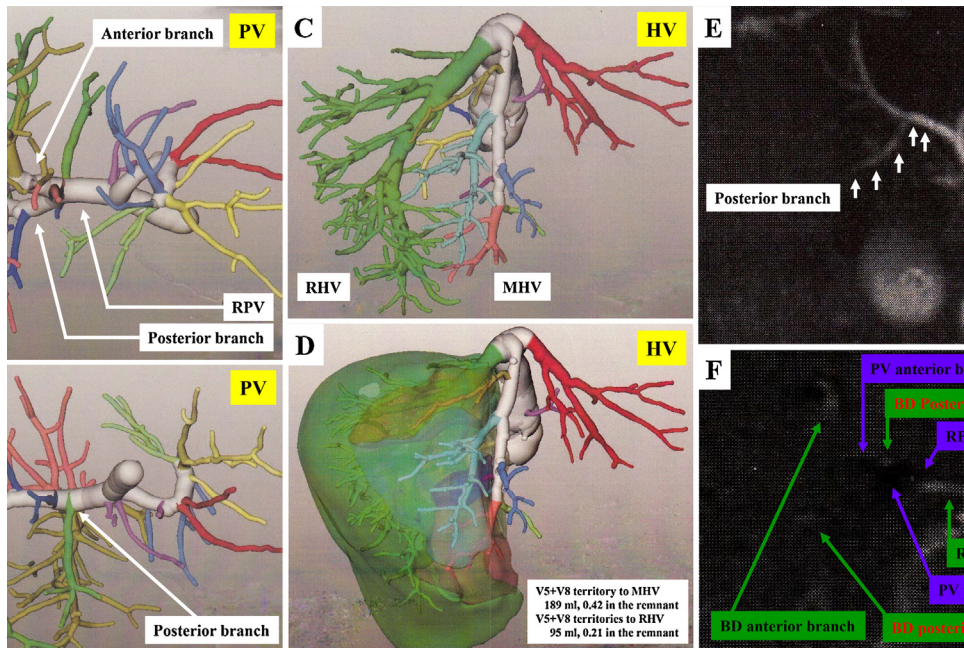


Fig. 1. Preoperative investigation in donor candidate. No anomalies were detected in the portal vein (A and B) and hepatic vein (C). The territory of drainage veins from segments 5 and 8 that flowed into the MHV was 189 mL (ratio in liver remnant, 0.42), although that flowing into the RHV was 95 mL (ratio in liver remnant, 0.21) (D). BD, bile duct; HV, hepatic vein; MHV, middle hepatic vein; PV, portal vein; RHV, right hepatic vein; RPV, right portal vein; V5, hepatic vein for segment 5; V8, hepatic vein for segment 8.

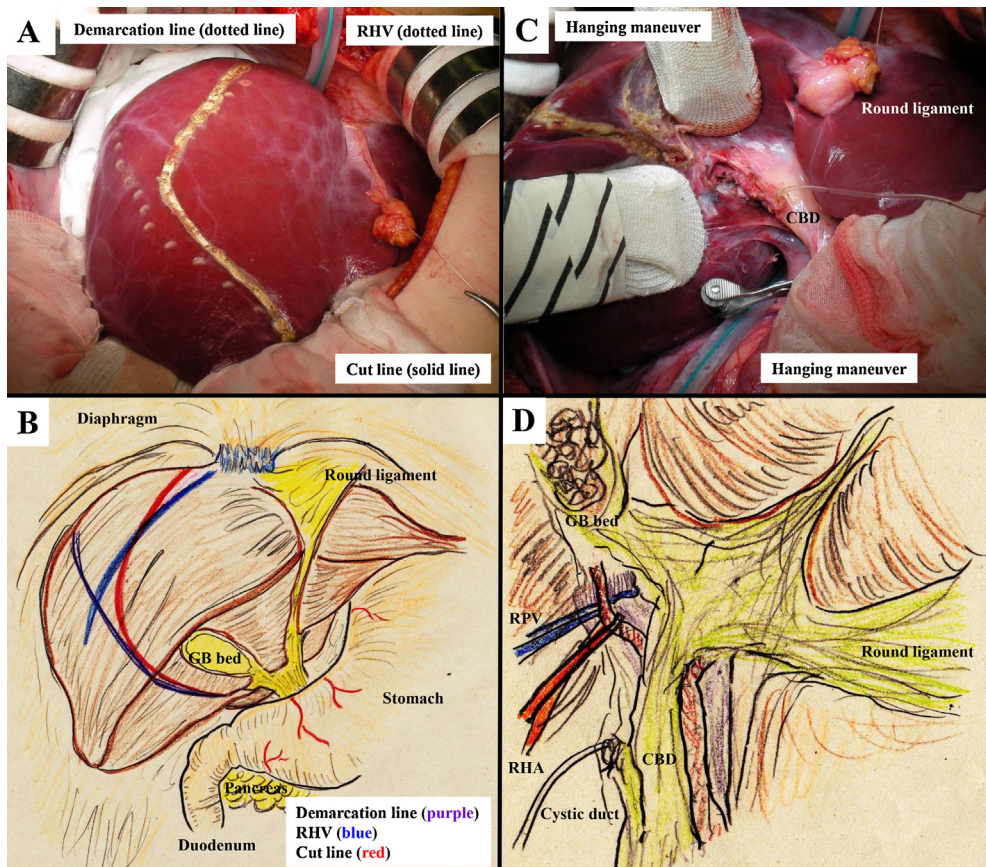


Fig. 2. Findings in donor operation. The RHV was marked (dotted line in A and blue line in B). A hanging maneuver for RHV was set, and a tube was inserted from the cystic duct (C). The right hepatic artery (red tape) and right portal vein (blue tape) were detected (D). After skeletonization of the posterior branches of the hepatic artery and portal vein, the demarcation line (dotted line in A and purple line in B) was marked by temporary clamping of the portal vein for the posterior segment. The cut line (solid line in A and red line in B) was carefully set based on the demarcation line and RHV. CBD, common bile duct; GB, gallbladder; RHA, right hepatic artery; RPV, right portal vein.

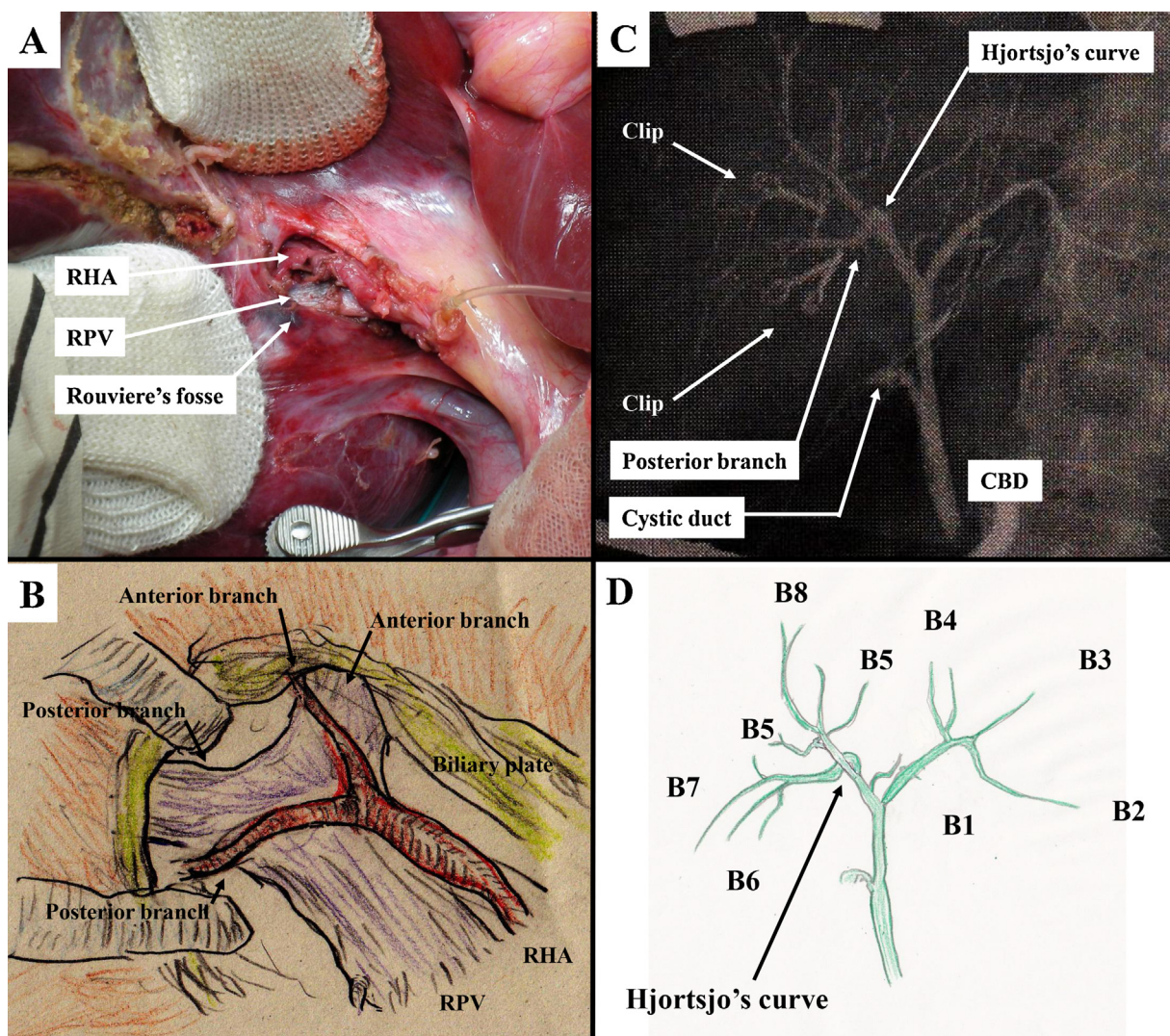


Fig. 3. Findings in donor operation. Rouviere's fosse was dissected according to the hepatic artery and portal vein (A). Anterior and posterior branches of the hepatic artery and portal vein were skeletonized, respectively (B). Clips were placed to estimate the cut line of the biliary plate. Cholangiography was performed and Hjortsjo's curve and posterior branch were confirmed (C). Biliary branches for each segment were confirmed (Biliary branch for segment x was shown as Bx, in D).

graft, the estimated graft volume was 469 mL, and the estimated ratio of liver remnant was 0.49. No anomalies were detected in portal and hepatic veins for posterior segmental graft (Fig. 1A–C). Territory of drainage veins from segments 5 and 8 that flowed into the MHV was 189 mL (ratio in liver remnant, 0.42), although that flowing into the RHV was 95 mL (ratio in liver remnant, 0.21) (Fig. 1D). No anomalies were detected in biliary ducts, and the posterior branch located in the front of the portal vein for the posterior segment (Fig. 1E and F).

In the donor operation, the RHV was demarcated by ultrasound (Fig. 2A and B). A hanging maneuver for the RHV was set. A tube was inserted from the cystic duct to the common bile duct (Fig. 2C). The right hepatic artery and right portal vein were skeletonized (Fig. 2D). Rouviere's fosse was dissected according to the hepatic artery and portal vein (Fig. 3A). Anterior and posterior branches of the hepatic artery and portal vein were skeletonized, respectively (Fig. 3B). The demarcation line was marked by temporary clamping of the portal vein for the posterior segment (Fig. 2A and B). Intraoperative cholangiography with clips was performed (Fig. 3C), and Hjortsjo's curve and posterior branch were confirmed (Fig. 3D). The cut line was carefully considered based on the demarcation line and RHV (Fig. 2A and B). Liver resection was performed using an

ultrasonic aspirator/dissector (Cavitron Ultrasonic Surgical Aspirator; Valleylab Inc., Boulder, CO, USA) and saline-irrigating bipolar (Fig. 4A), and the RHV was confirmed on the cut surface (Fig. 4A and B). The biliary duct, hepatic artery, and portal vein for the posterior segment were cut (Fig. 4C), and then the RHV was cut. Thus, RPSG was harvested, and graft perfusion was completed by histidine–tryptophan–ketoglutarate solution. The RHV, portal vein, and biliary duct were sutured, and thereafter, no biliary leakage was confirmed by cholangiography with dye (Fig. 4D). The donor's postoperative course was uneventful.

In the recipient operation, the operative time was 18 h 13 min, and blood loss was 8910 mL. Native liver volume was 2500 g. Actual graft weight was 390 g, and actual GRWR was 0.54. Cold and warm ischemic times were 155 and 35 min, respectively. Hepatic venous reconstruction was achieved with an anterior patch using the ovarian vein. The portal vein was reconstructed with an interposition using the recipient's left internal jugular vein (Fig. 4E). Hepatic arterial reconstruction was achieved using interpositions of the recipient's left gastric and splenic artery (Fig. 4F), because the diameter of the hepatic artery in the graft was 1.0 mm. Biliary reconstruction was achieved by cholangiojejunostomy. Initial, recirculated and final pressures of the portal vein were 17, 25, and

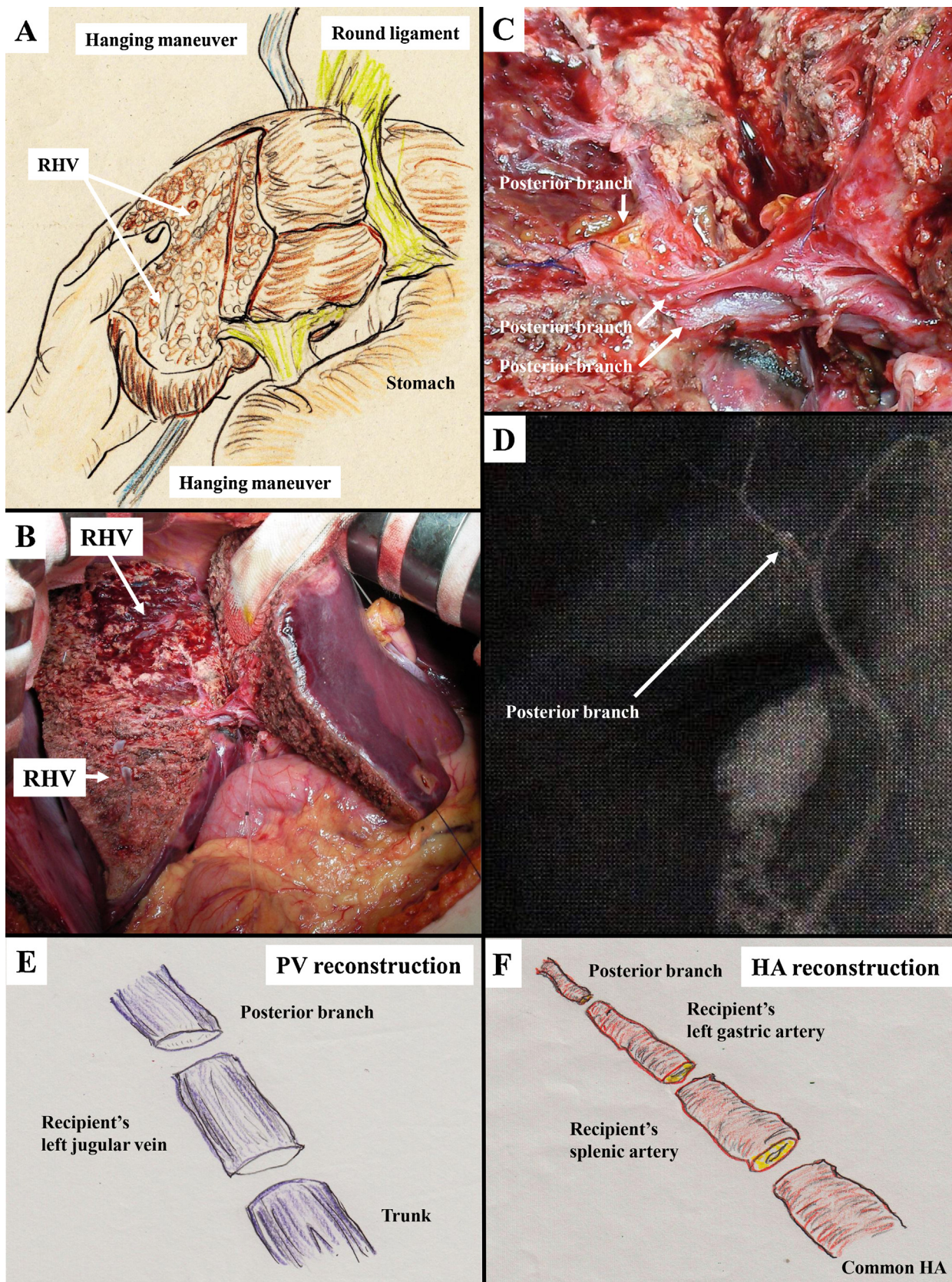


Fig. 4. Findings in donor and recipient operations. Liver resection was performed by a hanging maneuver technique, and RHV was confirmed on the cut surface (A and B). Biliary duct, hepatic artery, and portal vein for the posterior segment were cut, and the RHV was cut. Thus, RPSG was harvested (C). No biliary leakage was confirmed by cholangiography (D). In the recipient operation, the portal vein was reconstructed with an interposition by using the recipient's left internal jugular vein (E). In the recipient operation, the hepatic artery was reconstructed using interposition of the recipient's left gastric artery and splenic artery (F). HA, hepatic artery; PV, portal vein.

22 mmHg, respectively. Hepatic arterial thrombosis, liver abscess, and severe infection triggered a poor postoperative course, and the recipient died at postoperative day 77 because of sepsis.

3. Discussion

The diameters of the segmental branches of the hepatic artery and portal vein may be small in RPSG, and surgeons must exercise some ingenuity in adjusting the anastomoses to an adequate length and diameter in the recipient operation. Some variations in the biliary duct are often observed in the posterior segment.^{4,5} Although variation in the solitary posterior biliary branch is possibly favorable for RPSG, biliary drainage of RPSG may be plural at the cut line of the biliary plate. Hence, detailed investigation of biliary drainage is also important, as well as the portal vein and hepatic artery.^{6–10} Short, small, and weak orifices of the second-order branches of the portal vein, hepatic artery, and biliary may cause intractable complications,^{1,4} and these complications can directly lead to a recipient's death.⁴

From the view point of the nutrition support before donation, we routinely checked the liver/spleen ratio in the CT value, and alimentary therapy and exercise regimen were introduced if this value ≥ 1.1 . Liver needle biopsy was performed only in suspicious case of non-alcoholic steatohepatitis.

In the present case, actual liver volume and GRWR were 390 g and 0.54, respectively, although estimated graft volume and GRWR were 469 mL and 0.65. Deciding on the actual cut line for RPSG involves some difficulties, because segmental areas based on inflows and outflows are complicated in the right lobe.⁸ The cut line should be carefully considered based on the demarcation line and RHV. Segmental territory based on inflow and that based on outflow never overlap completely, even in the same segment. Preoperative recognition of territories based on imaging studies is important to make a decision about the cut line and to harvest the RPSG.^{8,9,11}

In terms of MHV anatomy for RPSG harvest, MHV territory from segments 5 and 8 in the liver remnant should be preserved for the donor safety. Venous drainage territory of segments 5 and 8 flowed into the MHV is strictly calculated beforehand, because unexpected congestion and/or massive bleeding during surgery in these segments mean a donor risk after surgery. We did not use hanging maneuver and cross-clamping techniques for MHV. The MHV was confirmed by ultrasound during surgery, and we intend to preserve the MHV territory as possible. Only small peripheral branches of MHV detected on the transaction surface were ligated by ultrasonic aspirator/dissector without venous reconstruction.

In the recipient operation, we intentionally controlled portal venous pressure (PVP) during LDLT, because PVP >15 mmHg results in an eventful postoperative course and poor outcome.¹² Final PVP in this recipient was 22 mmHg, and this higher PVP may trigger severe complications and poor outcome.

Sugawara et al. suggested that the selection of RPSG could be a useful option and increase the living-donor pool for LDLT.^{2,3,13} However, RPSG has not been widely used in LDLT, for several reasons, such as lack of popularity of RPSG, technical concerns, and surgical difficulties.¹ The selection of RPSG based only on donor liver volume criteria might be unfeasible, because of the complicated pedicular anatomy of the posterior segment.⁴ Controversy exists about the selection criteria for RPSG for LDLT.^{1,3,4} Donor selection for LDLT should be strict, and donor safety is guaranteed. As described above, detailed preoperative studies of inflow, outflow, and biliary drainage are important,^{8–11} and careful evaluation is required for the choice of RPSG. Careful consideration during surgery is also important for RPSG harvest.^{8,14,15}

4. Conclusion

RPSG is a useful tool for LDLT, but should be never simply chosen based on graft volume. Careful consideration is required before and during surgery.

Conflict of interest

No financial conflicts of interest.

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Ethical approval

This case report is written based on institutional ethical committee.

Author contributions

T. Hori wrote the paper. T. Hori, K. Ogawa, and T. Kaideo performed donor surgery. Y. Ogura and K. Ogawa performed recipient surgery. F. Oike, Y. Ogura, and K. Ogawa provided key points for donor selection and surgery. S. Uemoto supervised this report.

Key learning points

- Right posterior segment graft (RPSG) for living-donor liver transplantation involves technical difficulties.
- We report a case of RPSG harvest in a living donor.

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