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LETTER TO THE EDITORS

# Novel technique of implantation for reversed modified right lobe graft from a donor with situs inversus totalis: new challenge in adult living donor liver transplantation

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Dear Sirs,

When a living donor has a situs inversus totalis (SIT), transplant surgeons encounter unique technical challenges for living donor liver transplantation (LDLT). Until now, one case of living donor right lobe graft, which has single right hepatic vein (RHV) orifice was reported [1]. Adult LDLT using a reversed modified right liver (mRL) graft from a donor with SIT has not been reported because reconstruction of portal vein and hepatic veins is a big challenge to transplant surgeons for performing successful LDLT. Herein, we describe a novel approach to overcome technical challenges for adult LDLT using reversed mRL with sizable middle hepatic vein (MHV) branches and inferior right hepatic vein (IRHV) from a donor with SIT.

In June 2010, a 50-year-old Korean male with alcoholic liver cirrhosis underwent adult LDLT using a reversed mRL graft from his 43-year-old wife. In consideration of liver volumetry and age of donor based on our donor selection criteria [2], a reversed mRL graft leaving MHV trunk in the remnant reversed left lobe was the suitable type of donor hepatectomy to ensure donor safety and adequate graft volume to the recipient. Reconstruction of four hepatic veins including reversed RHV, sizable (≥5 mm) one IRHV and two segment 5 MHV branches (V5s), two hepatic arteries, one portal vein, and single bile duct were necessary on the preoperative computed tomography (CT) and magnetic resonance cholangiography.

Donor procedure was performed using a standard technique for donor right lobectomy in reversed fashion [3]. At the bench, when the reversed mRL graft was rotated by 180° along the axis of vena cava groove, the positions of all anatomical structures were inversed between left and right, and also between dorsal and ventral side (Fig. 1a). Reversed RHV was fenced with bisected autogenous great saphenous vein (GSV) to make a wide orifice having funnel-shaped neck, and so as to perform a tension-free anastomosis and to prevent hepatic vein stenosis. The most dorsally positioned two adjacent reversed V5s having thin and fragile walls and short stumps were also fenced with bisected autogenous GSV after making a single orifice by bridging two reversed V5s with GSV patch, and then anastomosed to polytetrafluoroethylene (PTFE) vascular conduit of 2 cm width diameter, which was devised to anastomose between multiple V5s and inferior vena cava (IVC) without undue tension, tearing, kinking [4,5]. Reversed IRHV positioned at the ventral side of the graft was anastomosed to cryopreserved iliac artery with long length for future anastomosis with trunk of middle and left hepatic vein (Fig. 1b).

In the recipient, hepatic hilum was dissected individually as high as possible to avoid undue tension during anastomosis. Under both supra- and infra-hepatic clamping of IVC, veno-venous bypass was instituted (both femoral vein and portal vein) to allow for unencumbered time and to make a good operation field during implantation. When we put the graft into the right upper quadrant space, the graft was rotated about counterclockwise 150° along the axis of the IVC groove and additionally rotated upward about 80–90° along the coronal axis to make an imaginary new axis between the donor's reversed RHV and PTFE graft, which is compatible with the IVC groove of conventional mRL graft (Fig. 1c).

The PTFE graft was first anastomosed to IVC because this anastomosis was positioned at the most dorsal site. The other anastomoses were performed in following sequence; reversed RHV, duct-to-duct biliary anastomosis, portal vein, ventrally located reversed IRHV to middle and left hepatic vein trunk with cryopreserved iliac artery, and two hepatic arteries (Fig. 2).

Immediate postoperative course was uneventful and the patient was discharged on month 1. Follow-up CT scan on postoperative 2 months showed ascites and stenosis of reversed RHV and V5. Endovascular stents were inserted to relieve stenosis in both hepatic veins. Currently, the patient is doing well 34 months after the LDLT.

Although mRL graft is the most common graft type in LDLT considering donor safety and avoidance of graft congestion [3], reversed mRL graft from a donor with SIT



 

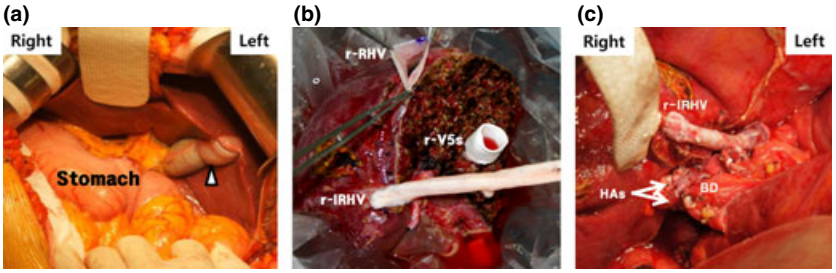


**Figure 1** Operative views of living donor liver transplantation using reversed modified right lobe graft. (a) Intraoperative view of the donor with situs inversus totalis revealed gallbladder (white arrowhead) at the left side to the round ligament. (b) Back-table view of the reversed modified right lobe (r-mRL) graft rotated counterclockwise 180° along the axis of inferior vena cava (IVC) groove. Reversed right hepatic vein (r-RHV) was fenced with bisected great saphenous vein (GSV) to get wide opening with adequate length of neck. Reversed inferior right hepatic vein (r-IRHV) analogous to middle hepatic vein branch of conventional mRL graft was interposed with cryoperserved iliac artery for anastomosis to middle and left hepatic vein trunk. Two adjacent reversed segment 5 middle hepatic vein branches (r-V5s) analogous to IRHV of conventional mRL graft were also fenced with bisected GSV after making a single orifice by bridging two r-V5s with GSV patch and then anastomosed to polytetrafluoroethylene (PTFE) vascular conduit having 2 cm width in diameter. (c) Completion view of implantation revealed r-IRHV anastomosed to middle and left hepatic vein trunk by cryopreserved iliac artery. Although r-RHV and PTFE graft were not visible in this picture, they were anastomosed to IVC. Anastomosis of the hepatic arteries were visible at the ventral side of the bile duct. The recipient's hepatic arteries were brought to the front side through the space between left border of the bile duct and right border of portal vein, and then anastomosed to the two hepatic arteries of the graft.

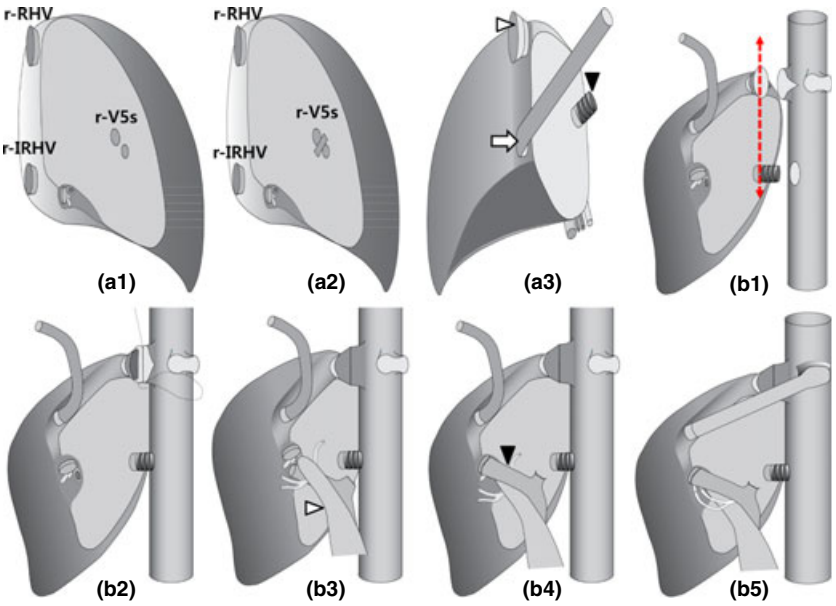


**Figure 2** Schema of the living donor liver transplantation using reversed modified right lobe (r-mRL) graft from a donor with situs inversus totalis. Bisected great saphenous vein (GSV) (a1) shows in situ reversed mRL graft having reversed two segment 5 middle hepatic branches (r-V5s), one reversed inferior right hepatic vein (r-IRHV), and two hepatic arteries (HAs). At the bench, r-V5s were made into single opening by bridging and fencing with bisected great saphenous vein (GSV) (a2), and anastomosed to the polytetrafluoroethylene (PTFE) vascular conduit with adequate width and length (black arrowhead), analogous to IRHV of the conventional mRL graft, for wide and safe anastomosis with inferior vena cava (IVC), and reversed right hepatic vein (r-RHV) was fenced with bisected GSV (white arrowhead), and r-IRHV analogous to middle hepatic vein branches of conventional mRL graft was interposed with cryopreserved iliac artery (white arrow) for future anastomosis with recipient's middle and left hepatic vein trunk (a2, a3). b1 shows implantation of r-mRL graft in the recipient by making an imaginary new axis indicated by bidirectional red arrow with dotted line between r-RHV and single hepatic vein opening transformed from r-V5s, which is compatible with IVC groove in the conventional mRL graft living donor liver transplantation, and upside-down positioned hilar structures including bile duct (BD), hepatic arteries (HAs), and portal vein (PV). Engraftment was performed in the following order; the r-V5s positioning like IRHV was first anastomosed to IVC attributable to deep and back-seated location, r-RHV was anastomosed to RHV which was incised toward anterior wall of IVC to adjust for transformed r-RHV axis, recipient's BD indicated by a white arrow was anastomosed to upside-down donor's BD and then right PV indicated by a black arrow to upside-down donor's PV such as dual-graft living donor liver transplantation using two left lobes, and finally donor's two HAs were reconstructed with recipient's right anterior and posterior HAs (b2–b5).

 

necessitating reconstruction of multiple hepatic vein openings is the first report. The major limitation is technically challenging multiple outflow reconstruction and successively high risk of outflow disturbance during postoperative course resulted from graft regeneration under unfavorable space between graft and recipient.

As a novel strategy to simplify the implantation procedures of the reversed mRL graft, imaginary new axis between reversed RHV and interposing PTFE graft has to be drawn, and then the anastomosis is the same as the conventional RHV and IRHV anastomoses.

Duct-to-duct biliary reconstruction was carried out prior to portal vein anastomosis such as dual-graft LDLT using two left lobes because donor's bile duct lay in the most dorsal side of the hepatic hilum. Although this method might increase warm ischemia time from 15 to 20 min, it never affected the postoperative outcome of the graft and recipient [6].

Although the shape of reversed mRL graft is remodeled postoperatively to fit the recipient's right upper quadrant space, the direction of graft regeneration is different from conventional mRL graft and it may result in delayed stenosis of the reconstructed hepatic vein. Hence, close monitoring and pertinent treatment for possible hepatic outflow complication is an essential step during postoperative follow-up in LDLT using reversed mRL graft from a donor with SIT.

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## Conflicts of interest

The authors declare no conflict of interest.

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