Clinical Case Report

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ABO incompatible living donor liver transplantation using dual grafts and pure laparoscopic donor right hepatectomy

A case report

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Abstract

Rationale: Because of the shortage of deceased donors, living donor liver transplantation (LDLT) has become the main procedure to treat patients with end-stage liver disease in Asian countries. However, many potential donors are excluded because of donor safety and graft volume issues. In addition, large abdominal wounds after open surgery for hepatectomy could be a reason for hesitating to agree to liver donation, particularly when attempting to recruit young female donors.

Patient concerns: On volumetric computed tomography (CT) examination, remnant liver volume was too small to guarantee the safety of the male donor, and the right hemiliver volume of the female donor was not sufficient to meet the recipient's metabolic demand. The young female donor also worried about a large abdominal wound following open surgery.

Interventions: We performed ABO-incompatible LDLT using dual grafts and right-sided graft was obtained by pure laparoscopic donor right hepatectomy in a young female donor.

Outcomes: The postoperative course was uneventful in both donors and the recipient is presently doing well in satisfactory condition 7 months after liver transplantation.

Lessons: We overcame these volumetric and cosmetic issues through dual living donor liver grafts using a combination of conventional surgery for 1 donor and laparoscopic right hepatectomy for a second ABO-incompatible donor. We think this procedure can be a good option for the expansion of donor pools.

Abbreviations: GRWR = graft-to-recipient ratio, HCC = hepatocellular carcinoma, LDLT = living donor liver transplantation.

Keywords: hepatectomy, liver transplantation, living donor, minimally invasive surgical procedures

1. Introduction

Recent technical advances in living donor liver transplantation (LDLT) have focused on the cosmetic aspects of donors and expansion of the donor pool. Regarding cosmetic issues, since pure laparoscopic right donor hepatectomy was first introduced by Soubrane et al in 2013,[1] several centers with expertise have adopted this as an attractive alternative to conventional donor hepatectomy via open surgery.[2–4] In addition, to expand donor pools, the exclusion rate of potential donors should be minimized. ABO incompatibility is no longer a reason to avoid live liver donation following the introduction of the anti-CD 20 monoclonal antibodies and a total plasma exchange program, and short-term weight reduction programs have shown effective outcomes for potential donors with severe fatty liver.[5] In addition, small remnant liver portions and a low graft-to-recipient ratio (GRWR) can be overcome through dual graft transplantation.[6]

In the present case, we applied all possible aspects of recent technical refinements on a patient with cirrhosis and hepatocellular carcinoma (HCC) to proceed to successful liver transplantation. We performed dual-graft LDLT with an ABO-incompatible graft obtained successfully using a purely laparoscopic right hepatectomy.

2. Case report

A 51-year-old man (height 166 cm, weight 68.5 kg) was diagnosed with hepatitis B-related liver cirrhosis and HCC in 2011. Thereafter, he received various treatments such as radiofrequency ablation, transarterial chemoembolization, and cryotherapy for recurrent HCC. In August 2017, he complained of a distended abdomen, and new large amounts of ascites and a 13 mm-sized hepatic nodule compatible with HCC at segment 3 was observed on an abdominal computed tomography (CT) scans. His ABO blood type was O^+ and the candidate donor (Donor 1) was his 58-year-old brother (height 166 cm, weight 63 kg), with blood type O^+. The volume of the donor's right hemiliver was calculated as 659 cm^3 and the projected GRWR

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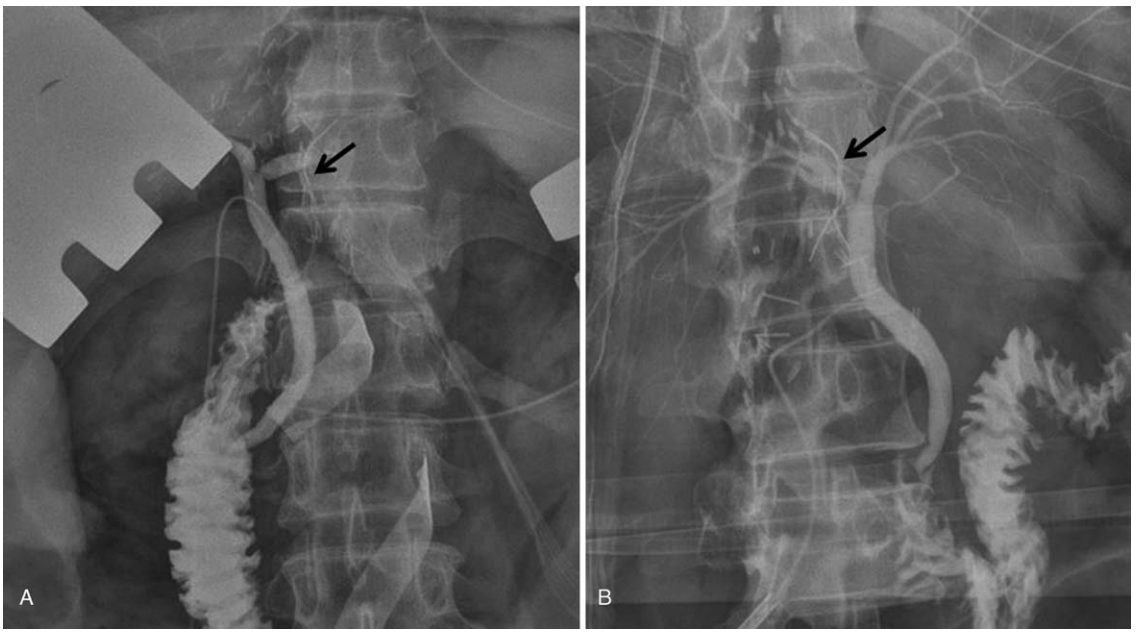

Figure 1. Intraoperative cholangiograms. A radiopaque rubber band was anchored at an adequate cutting point as a marker (arrow). (A) Cholangiogram of Donor 1 who underwent conventional open surgery for a left lateral sectionectomy. (B) Cholangiogram of Donor 2 who underwent laparoscopic right hepatectomy.

was 1.04. However, the remnant liver volume was 280 cm^3 (29.8% of total liver volume), which was too small to guarantee the donor's safety. Therefore, we asked for other candidates and his 42-year-old sister with ABO type A^+ blood group volunteered to be evaluated for a donor work-up. On volumetric CT examinations, the remnant liver volume was adequate for the donor's safety, but the right hemiliver volume was not sufficient to meet the recipient's metabolic demand: the expected right

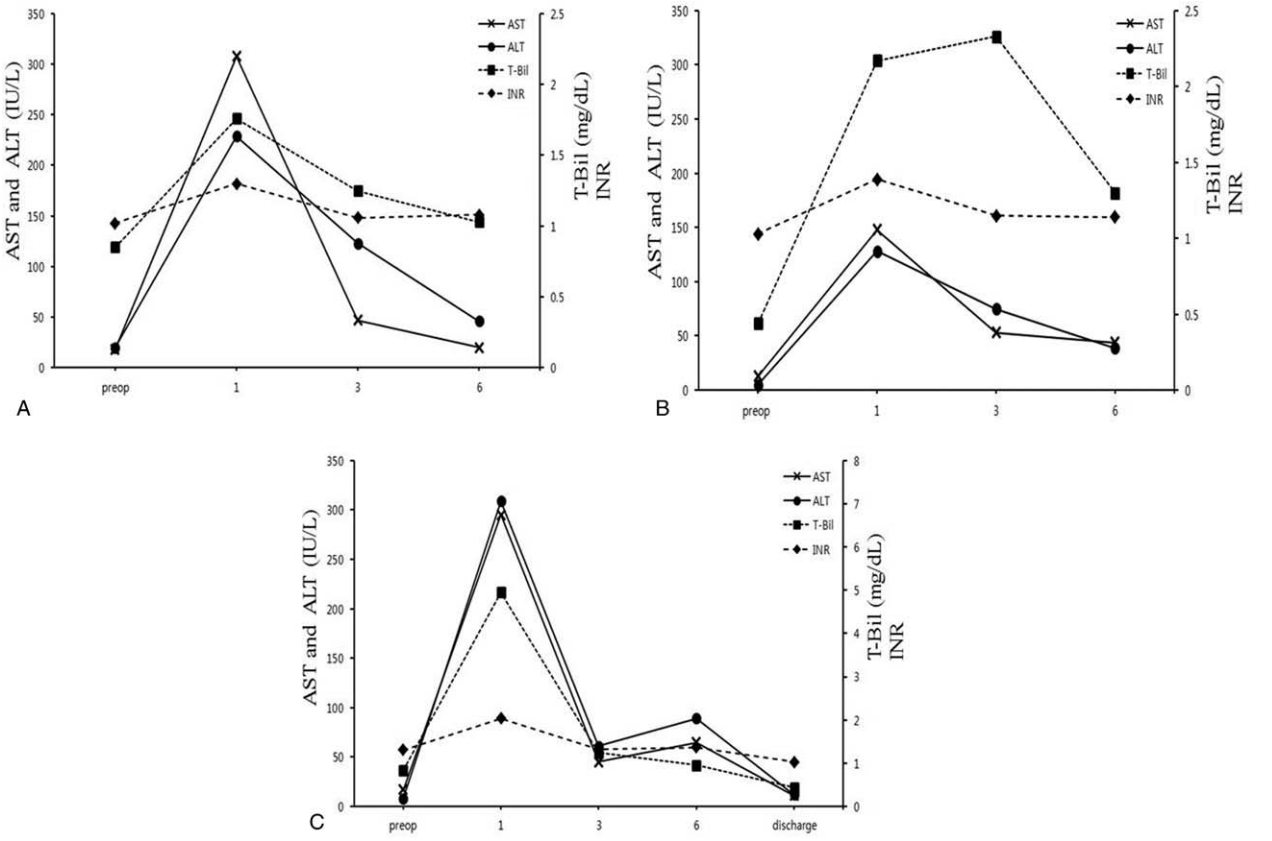

Figure 2. Pre and postoperative laboratory results of the 2 donors and recipient. (A) Donor 1. (B) Donor 2. (C) Recipient.

Figure 3. Abdominal dynamic computed tomography scans of the recipient performed 4 months after liver transplantation. (A) Axial view. (B) Coronal view.

hemiliver volume was 443 cm^3, the GRWR was 0.65, and the ABO isoagglutinin (IA) titer was 1:64. When we explained the potential risks of dual graft LDLT using ABO-incompatible liver transplantation and laparoscopic donor hepatectomy, both candidates gave their consent to our plan and the sister (Donor 2) agreed to undergo laparoscopic hepatectomy. Three weeks before surgery, the recipient was administered a single dose of rituximab (300 mg/m^2 per body surface area) and then twofold total plasma exchange was applied to reduce the IA titer, resulting in a titer of 1:8.

Laparoscopic right hepatectomy for his sister (Donor 2) was done as reported previously.[7] In brief, she was placed in a left decubitus position, and the liver was freed from its supporting ligaments. Then, the vena cava ligament and the short hepatic veins were isolated and ligated, which proceeded to the groove between the right and middle hepatic vein. Thereafter, the right portal vein (RPV) and right hepatic artery (RHA) were dissected and encircled, which was followed by temporary clamping of these to identify the transection plane demarcated on the liver surface. Hepatic parenchymal transection was performed using a laparoscopic Cavitron Ultrasonic Surgical Aspirator without intermittent hepatic inflow occlusion or a hanging maneuver. When the liver transection reached the hilar plate, caudate lobe division was followed, and then the hilar plate was encircled. After confirmation of an accurate cutting point of the bile duct, the stump of the remnant bile duct was closed with Hem-o-lok clips and the bile duct was divided with scissors. The graft was extracted through a Pfannenstiel incision. Left lateral sectionectomy for the recipient's brother (Donor 1) was performed using a conventional open surgery technique. In both donors, to verify the optimal bile duct division point, a radiopaque rubber band was anchored at an adequate point as a marker and intraoperative cholangiograms were obtained via catheters cannulated into the cystic duct (Fig. 1).

In the recipient, we divided the hepatic artery and portal vein above the second branches, and the bile duct was cut intrahepatically to obtain long structures for anastomosis. After total hepatectomy of the recipient, the grafts were implanted orthotopically into the corresponding liver fossa. Next, we reconstructed the right hepatic vein (RHV), left hepatic vein (LHV), and left portal vein sequentially, and reperfusion of the left-sided graft was done in advance: To facilitate LHV anastomosis, a vascular clamp on the RHV was replaced with a smaller vascular clamp after completion of the RHV anastomosis. For outflow reconstruction of the left-sided graft, a vascular clamp on the middle and left hepatic vein trunk was replaced with a larger one, which was applied deeply down to the inferior vena cava (IVC), and the venous septum was divided to create a common wide orifice. The hepatic artery anastomosis was performed under an operating microscope and the bile ducts were reconstructed using a duct-to-duct manner in both grafts. We did not install a veno-venous bypass and it took 580 minutes to complete the dual graft LDLT.

The postoperative course of the 2 donors and the recipient were uneventful and the results of the laboratory tests were performed just before discharge were within normal range (Fig. 2). A postoperative follow-up CT scan of the patient showed that both grafts had adopted the shape of a normal liver, and the patient is presently doing well in satisfactory condition 7 months after liver transplantation (Fig. 3). Ethical approval was waived by the medical ethics committee of Kyungpook National University Hospital to publish this study and the patient provided written informed consent for publication of this report.

3. Discussion

LDLT has become the main procedure for liver transplantation in Asian countries because of the scarcity of deceased donor organs. In South Korea, 942 cases of LDLT was performed in 2015, and donors under the age of 35 and lineal descendants comprised two-thirds of all live donors, respectively. In addition, there were 320 cases of donation from female donors.[7] Such a composition of young female donors and lineal descendants gives surgeons concern about cosmetic and recovery problems after conventional open hepatectomy in the donors. In addition, the large abdominal wound following open surgery could be a reason for withdrawing operative consent. Accordingly, a few transplant centers have adopted laparoscopic hepatectomy as a first line procedure for donors in LDLT procedures, and with refinements in surgical techniques and equipment, a recent study showed similar complication rates between laparoscopic and open surgery hepatectomy for the donors.[2]

Regarding the exclusion rate during the live donor evaluation, Nugroho et al reported that 219 of 726 potential donors were excluded initially because of medical problem, withdrawal of consent and a small remnant liver volume/low GRWR.[5] If the

team expects a small remnant liver volume after graft donation, the potential donor should be excluded because their safety is of paramount importance. Also, small grafts that are not sufficient to meet the recipient's metabolic demands can result in poor outcomes. To overcome these problems, LDLT with dual grafts could be a good option by obtaining sufficient graft volume and leaving large remnant liver portions, but this procedure needs technical expertise, multiple anastomoses, equivalent equipment, long operation time and, above all, 2 donors having to face surgical risks. However, we must consider the risk–benefit ratios for both donors and recipients. A recent multicenter study also has shown favorable results after live liver donation with a major complication rate of only 1.9%.[8]

4. Conclusions

In the present case, we overcame the problems of ABO blood type incompatibility, a small graft, and potential risks to donors, through dual graft LDLT using an ABO-incompatible graft. In addition, we performed a pure laparoscopic donor right hepatectomy to meet the cosmetic needs of the donor. It is mandatory to verify the safety and reproducibility of our procedure through further studies, but we believe our case can be a good model for advancing surgical techniques in LDLT.

Author contributions

Conceptualization: Young Seok Han, Jae Min Chun.
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Writing – review & editing: Young Seok Han, Heontak Ha, Ja Ryung Han, Kyoung Hoon Lim, Jae Min Chun.

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