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CASE REPORT

Totally laparoscopic living donor right hepatectomy in a donor with trifurcation of bile duct

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Summary Donor operation in adult living donor liver transplantation is associated with significant postoperative morbidity. To avoid laparotomy wound complications and shorten postoperative recovery, laparoscopic liver graft harvest has been developed recently. However, to determine the cut point of bile duct is challenging. Herein, we report the application of totally laparoscopic approach for right liver graft harvest in a donor with trifurcation of the bile duct. A19-year-old man volunteered for living donation to his father who suffered from hepatitis B virus-related cirrhosis of liver and hepatocellular carcinoma. The graft was 880 mL with a single right hepatic artery and portal vein. The graft to recipient weight ratio was 1.06. The middle hepatic vein was preserved for the donor and the liver remnant was 42.3%. Two branches of middle hepatic veins were $>$ 5 mm in diameter and needed reconstruction with cryopreserved allograft. Ductoplasty using laparoscopic intracorporeal suture technique was done to achieve single orifice of the graft bile duct. The postoperative course was uneventful for the donor. This report adds evidence of the feasibility of pure laparoscopic right donor hepatectomy and describes the necessary steps for bile duct division in donors with trifurcation of bile duct.

Conflicts of interests: All authors listed have no conflicts of interest or financial ties to disclose.

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1. Introduction

In countries with low cadaveric organ donation rates, living donor liver transplantation is one of the essential treatments for patients with end-stage liver disease. However, donor operation is associated with significant postoperative complications.[1] Most morbidities are related to the biliary tree or laparotomy wound.[2] Some modifications of donor operation have been advocated to improve the donor recovery. Nagai et al[3] reported midline laparotomy for right donor hepatectomy. Hand-assisted laparoscopic right donor hepatectomy has been reported by Koffron et al.[4] Wakabayashi et al[5] reported a hybrid approach that involved laparoscopic mobilization of the right liver. Parenchyma transection and hilar dissection were performed through a right subcostal incision using traditional instruments.[5] Cherqui et al[6] reported pure laparoscopic donor hepatectomy for pediatric liver transplantation using a left lateral section graft in 2002. Despite the exponential development of laparoscopic hepatectomy, pure laparoscopic donor hepatectomy has been used almost exclusively in pediatric liver transplant in the past. With the accumulation of experience of laparoscopic major hepatectomy, especially the dissection around great vessels[7,8] and techniques for biliary reconstruction,[9] laparoscopic right hepatectomy has become an acceptable procedure.[10]

Soubrane et al[11] reported the first pure laparoscopic right donor hepatectomy in 2013. To date, only sporadic case reports of laparoscopic right donor hepatectomy for donors with favorable anatomy can be found in the literature and the standard technique remains to be established.[12,13] The main reason is probably the complexity of the procedure including the division of the bile duct. For donors with trifurcation of the bile duct, the determination of cut end of the bile duct could be even more challenging in pure laparoscopic right donor hepatectomy.

2. Case report

The donor was a 19-year-old man, willing to donate his right liver to his father who was a hepatitis B carrier with cirrhosis of the liver. The recipient also had hepatocellular carcinoma and had received hepatectomy previously. The tumor recurred and he received multiple sessions of transarterial chemoembolization. He also suffered from repeat esophageal and gastric variceal bleeding. Therefore, after thorough physical and psychosocial evaluation, he was put on the waiting list for liver transplantation. His pretransplant model for end-stage liver disease score was 10. Due to a scarcity of deceased donors in our country, living donor transplantation was suggested. The donor received thorough physical and psychosocial evaluation to determine the feasibility and safety of right liver donation. Comprehensive liver images had been performed, including computed tomography, magnetic resonance imaging cholangiography, and volumetry. The whole liver volume of the donor was 1474 mL and the right liver (segments 5–8) without the middle hepatic vein (MHV) was 940 mL. The graft/recipient weight ratio for the recipient was 1.11. The liver remnant was 536 mL, 36% of the original liver volume of the donor. Two branches of MHV that were $>$ 5 mm in diameter needed reconstruction. Therefore, resection plane modification to decrease graft volume and increase liver remnant was planned prior to the surgery. Liver image of the donor revealed single right hepatic artery and adequate distance between right and left portal vein branches. However, magnetic resonance imaging cholangiography demonstrated trifurcation of the bile duct (Fig. 1A).

The results of pretransplant evaluation of the donor and recipient were presented to the ethics committee of our institute. Informed consents were obtained from the donor himself and two close family members after full explanation of the potential risks of liver donation and laparoscopic surgery. The originality of the laparoscopic right donor hepatectomy had been explained to the donor and his family. The potential risks and possible conversion to laparotomy were also informed, despite the experience of more than 50 laparoscopic right hepatectomies and the success of the previous five pure laparoscopic right donor hepatectomy without open conversion in our team.

This living donor liver transplantation surgery was authorized in advance by the National Health Insurance administration in Taiwan.

2.1. Surgical procedure

Under endotracheal general anesthesia, the donor was placed in the reverse Trendelenburg position. The port positions are illustrated in Fig. 2. The operating surgeon stood between the donor's legs. The assistant surgeon and cameraman were at the left side of the donor. The CO_2 insufflation pressure was set at 15 mmHg through the whole procedure. Following initial mobilization of the right liver, the Calot's triangle was dissected. The cystic artery was divided between metallic clips and the gall bladder was freed from the liver bed. The cystic duct was prepared for intraoperative cholangiography (IOC). Dissection of the right hepatic artery and right portal vein followed (Fig. 3). These two structures were looped with vascular tapes.

Intraoperative ultrasonography was done to identify the MHV. The parenchymal transection plane was determined by the branching pattern of MHV. A harmonic scalpel (Ethicon Endosurgery, Cincinnati, OH, USA) was used for parenchymal transection. The cut point of the bile duct was determined by real time fluoroscopic IOC. Biliary probe was also used to identify the trifurcation point of the right and left bile duct (Fig. 4). After completing liver parenchyma transection, the bile duct was cut on the branching point between the right anterior duct and common hepatic duct. Then the cut plane went upward to include the right posterior duct in a common patch. A single orifice of the bile duct was achieved in this right liver graft. Horizontal ductoplasty using laparoscopic intracorporeal suture technique was done (Fig. 5). Then a Pfannenstiel incision was made. Hepatic artery and portal vein were divided using Hem-o-Lok (Weck Surgical Instruments, Telefex Medical, Durham, NC, USA). The right hepatic vein was divided with a vascular stapler (Endopath Endocutter; Ethicon Endosurgery). Then the graft was put in a retrieval bag and removed. Graft perfusion using histidine–tryptophan–ketoglutarate solution started immediately. Venoplasty for the graft right hepatic vein and reconstruction of the branches of middle hepatic vein using cryopreserved allograft were done prior