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Successful Use of Double ePTFE Graft for Inflow and Outflow Reconstruction in a Living Donor Liver Transplant

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Background	Prosthetic vascular graft has been widely applied in the reconstruction of hepatic venous outflow in a living donor liver transplant (LDLT), but has never been reported in re-building portomesenteric inflow in patients with extensive portal vein thrombosis (PVT). Herein, we report a liver recipient successfully undergoing an LDLT for viral hepatitis B related end stage liver disease and grade 3 PVT. Double layer-expanded polytetrafluoroethylene (ePTFE) was utilized to reconstruct hepatic outflow and porto-mesenteric venous inflow concurrently.
Summary	The patient was discharged on posttransplant day 20 without any sequelae and has been followed for one year without recurrent PVT. With our successful experience, we be-lieve that ePTFE grafts used for the inflow and outflow reconstruction may be a reliable alternative method in managing LDLT recipients with extensive PVT.
Conclusion	Applying the ePTFE grafts for the inflow and outflow reconstruction may be a reliable alternative method in managing LDLT recipients with extensive PVT.
Keywords	ePTFE Graft; Inflow reconstruction; Outflow reconstruction; Living donor; liver transplant

DISCLOSURE:
The authors have no conflicts of interest to disclose.

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Introduction

Portal vein thrombosis (PVT) is one of the most challenging complications of end-stage liver disease. The incidence of PVT in stable liver disease ranges from 0.6 to 16 percent.[1] In the past, PVT was considered a contraindication for liver transplantation due to an increased risk of perioperative complications. With increasing experience, most benign PVT could be effectively managed by either thrombectomy or jump graft.[2] Cryopreserved vascular grafts are usually used as interposition or jump grafts for vascular reconstruction in liver recipients with extensive PVT.[3] However, utilization of a prosthetic graft as a jump graft in portomesenteric venous reconstruction in recipients with PVT has not been reported before. Herein, we show in this report the feasibility of using double ePTFE grafts for inflow and outflow reconstruction in living donor liver transplant (LDLT) for a patient with extensive PVT.

Case Presentation

A 55 year-old male was diagnosed with viral hepatitis B related liver cirrhosis with end stage liver disease, Child-Pugh C, complicated by refractory ascites, and esophageal variceal bleeding. Therefore, the patient was referred to our center for LDLT.

The preoperative abdominal computed tomography (CT) scan showed grade 3 PVT (i.e., complete portal vein and proximal superior mesenteric vein thrombosis) with peri-portal cavernous transformation (Figure 1). The patient's daughter, a healthy 26-year-old ABO-compatible donor, donated her right hepatic lobe for LDLT. The graft-to-recipient weight ratio (GRWR) was 0.9 percent. The outflow reconstruction was prepared at back table using an 8mm expanded polytetrafluoroethylene (ePTFE) graft to create a single conduit to drain all venous outflow arising from anterior sector (V4, V5, V8) and the right hepatic vein.

Figure 1. Grade three PVT with peri-portal cavernous transformation.

Venous outflow was reconstructed by anastomosing the customary ePTFE conduit to the inferior vena cava using 5-0 Hemo-Seal Prolene running suture. It was challenging to perform embolectomy or dissect out the portal vein from the hepatoduodenal ligament. Therefore, we looped the superior mesenteric vein distal to meso-colon level after dissecting and ligating all surrounding collateral veins (Figures 2A and 2B). A retrocolic jump graft was established between the right portal vein of the liver graft, and the donor's superior mesenteric vein using a 12mm ePTFE graft by end-to-side running suture anastomosis with 6-0 Hemo-Seal Prolene (Figure 3). After reperfusing the liver graft, the graft artery was anastomosed to the recipient's proper hepatic artery.

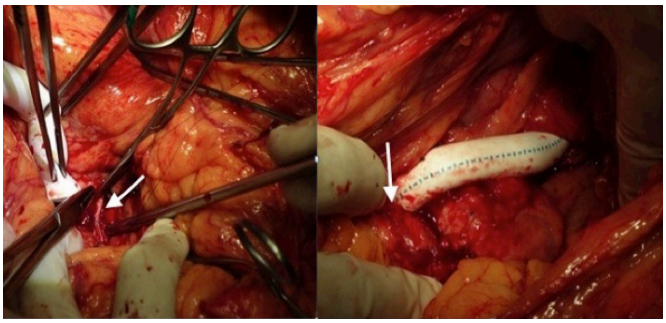

Figure 2A (Left). After ligating the collateral vessels, the superior mesenteric vein (white arrow) was looped at the level distal to meso-colon level and used for end to side anastomosis. **Figure 2B** (Right). A 12mm ePTFE jump graft between graft portal vein and superior mesenteric vein (white arrow) through the mesocolon.

The vascular flow was evaluated by a transit-time flow measurement (VeriQ flowmeter, Medistim ASA, Oslo, Norway). The flow of portal vein was more than 1500 ml/min, and that of hepatic artery was 91ml/min. The complete ischemia time was 142 minutes (warm ischemic time = 49 min; cold ischemic time = 93 min; anhepatic phase = 76 minutes) and a total blood loss was around 4,000 cc.

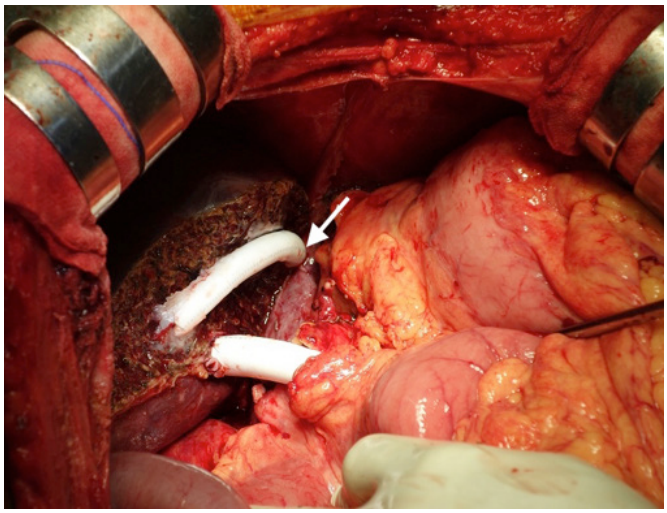

Figure 3. Double ePTFE graft. One was for the hepatic venous outflow reconstruction (white arrow) into the IVC; the other one was retrocolic jump graft for portomesenteric venous reconstruction.

On posttransplant day 1, color Doppler ultrasonography for the liver graft revealed the patency of hepatic vein, portal vein and hepatic artery. Right and middle hepatic veins showed a triphasic flow with a velocity of 38.4cm/s and 25.9cm/s, respectively. A portal vein flow velocity of 47cm/s was reported without any thrombus or stenosis, and a normal hepatic artery flow (mean flow velocity= 23cm/s) was recorded as well. The posttransplant liver enzymes decreased rapidly (Alanine aminotransferase =3.05μkat/L, total bilirubin =11.97μmol/L on posttransplant day 7).

Aspirin (100mg/d) and warfarin were prescribed since third day posttransplant with a targeted INR value of 2.5 to keep patency of the artificial graft. On posttransplant day 7, CT scan showed patency of both ePTFE grafts (Figures 4A and 4B). The patient was discharged on posttransplant day 20 without any sequelae (e.g., renal dysfunction, ascites, or encephalopathy). Currently, he is under regular outpatient follow-up for one year, and no major adverse events have occurred.

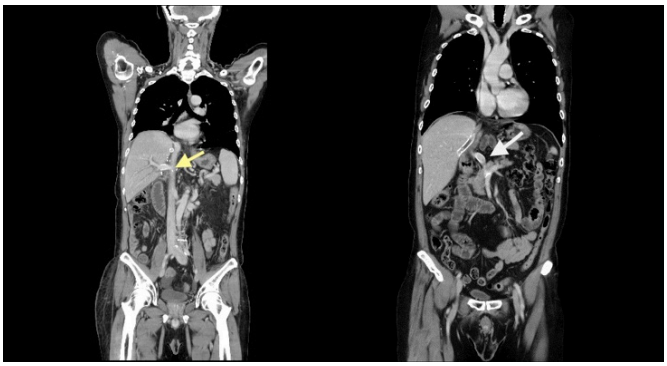

Figure 4A Left). Patent jump graft (white arrow) to the portal vein on posttransplant day 7. **Figure 4B** (Right). Patent jump graft (white arrow) to the superior mesenteric vein one year postransplant.

Discussion

This is the first reported case to successfully utilize double prosthetic grafts for managing extensive PVT and for hepatic venous outflow reconstruction in LDLT.

Rapid restoration of portomesenteric inflow and venous outflow in the liver graft is critical in liver transplant. The safety and efficacy of using ePTFE grafts in the hepatic outflow reconstruction have been well established, with a low rate of stenosis, thrombosis, or infection. It can also reduce warm ischemic time by rapidly anastomosing a well-prepared customary prosthetic venous conduit to inferior vena cava.[4] In our series, the two-month patency rate of ePTFE vascular graft was 100 percent, which is essential to substantial liver regeneration at the immediate posttransplant stage.[4] However, prosthetic vascular grafts have never been reported with regards to reconstructing portomesenteric venous inflow in LDLT for patients with extensive PVT.

PVT secondary to underlying liver cirrhosis often makes surgery more challenging and increases operative complexity. Lower dissection of the portal vein and thrombectomy could resolve most of grade 1 or 2 PVT in liver transplant.[2] However, an interposition or jump vascular graft may be needed in case of grade 3 or 4 PVT. Cryopreserved vascular graft is preferred as a jump graft for portomesenteric venous thrombosis because it is less thrombogenic and particularly helpful in a low-flow vascular system.[1] That said, we still had to use non-ringed ePTFE prosthetic vascular grafts because of the unavailability of cryopreserved vascular graft in our hospital. To reduce ePTFE graft-related thrombogenic influence on the low-flow vascular system, we ligated all collateral varices around the superi-

or mesenteric vein anastomosis site to increase portomesenteric flow. We believe that this maneuver is essential to increasing portovenous flow to the liver graft, particularly for those with extensive portomesenteric venous thrombosis accompanied by abundant collateral circulation.

After vascular reconstruction, antiplatelet and anticoagulant therapy were offered to the patient since posttransplant day three to reduce thrombogenic influence. Currently, antiplatelet rather than anticoagulant was suggested in patients who received ePTFE vascular graft for hepatic venous outflow reconstruction in LDLT.[5]_We prescribe 100mg of aspirin once a day for two years for those receiving prosthetic vascular grafts in hepatic venous outflow reconstruction.[4] To ensure adequate portomesenteric venous inflow, the patient was provided antiplatelet and anticoagulant therapy concurrently while posttransplant hemorrhage was excluded.

Conclusion

Concurrently applying the ePTFE grafts for the inflow and outflow reconstruction may be a reliable alternative method in managing LDLT recipients with extensive PVT.

Lessons Learned

The patient was discharged on posttransplant day 20 without any sequelae and has been followed for one year without recurrent PVT. With our successful experience, we believe that ePTFE grafts used for the inflow and outflow reconstruction may be a reliable alternative method in managing LDLT recipients with extensive PVT.

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