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Rex Shunt for Portal Vein Thrombosis after Adult Living Donor Liver Transplantation

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Abstract

Portal vein thrombosis (PVT) after liver transplantation is a relatively common but serious complication which could lead to portal hypertension or a direct graft loss. A “Rex” shunt created between the superior mesenteric vein (SMV) and the umbilical portion of the left portal vein can be a useful option to treat PVT after pediatric liver transplantation, however, its application to adult patients has not been reported so far because appropriate vein grafts are hardly available. Herein we present a case of PVT after left lobe living donor liver transplantation (LDLT) who underwent the procedure using the own inferior jugular vein and the gonadal vein as a shunt graft. The shunt was patent immediately after the procedure but was thrombosed 2 days after probably due to the insufficient inflow from the SMV and the absence of anticoagulation therapy, for which emergent thrombectomy and ligation of the significant hepatofugal collateral veins followed by full anti-coagulation therapy were performed. The shunt remains open at 8 month after the procedure with a normal ammonia level and liver function. In conclusion, the Rex shunt using recipient's autologous vein grafts is a feasible and valuable option for adult patients to treat PVT after LDLT.

Key words : Portal vein thrombosis · Liver transplantation · Rex shunt · Umbilical portion

Introduction

Portal vein thrombosis (PVT) after liver transplantation (LT) is a relatively common but devastating problem. Early postoperative PVT is often successfully treated by direct thrombectomy or radiological intervention, however, late PVT is not usually amenable to those interventions. Moreover, it eventually leads to portal hypertension and graft loss if left untreated and the prognosis is revealed to be very poor especially in small children¹. Surgical treatment options for late PVT include distal splenorenal shunt, other portosystemic shunt, retransplantation and mesentericoportal vein bypass or “Rex

shunt”.

The Rex shunt was first reported in 1992² and has proved to be an efficacious modality to treat extrahepatic portal vein obstruction³⁻⁵ and has been applied to PVT after LT in children⁶⁻⁸ where there is favorable anatomy including patency of the umbilical portion (UP) of the left PV in the Rex recessus and the infrapancreatic SMV. Herein we present and discuss on the first successful case of the Rex shunt for PVT after adult left lobe (LL) living donor liver transplantation (LDLT).

Case Report

A 47-year-old Japanese female patient under-

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went ABO-incompatible LDLT for giant hemangioma of the liver and Kasabach-Merritt syndrome (operative time, 739 min ; Blood loss, 1770 ml). The graft was her husband's LL graft including the caudate lobe. The graft weight was 448g and the graft-to-standard liver volume ratio was 40.2%. Splenectomy was concomitantly performed as per our protocol for ABO incompatible LDLT. The intraoperative doppler ultrasound confirmed adequate portal venous flow after reperfusion. The immunosuppressive protocol for our ABO-incompatible LDLT was as described elsewhere⁸. The postoperative course of the patient was uneventful with normal PV flow until 14 postoperative days (POD) and she was discharged home at 20POD without anticoagulation therapy. Thereafter, she had been well until 17 days after discharge, when she developed hepatic encephalopathy, for which CT scan revealed PVT extending from the UP of the LL graft to the distal SMV. Liver function tests were otherwise unremarkable with an ammonia level of 153 $\mu\text{g}/\text{dl}$. Administration of nonabsorbable disaccharides (Lactulose®), branched chain amino acids product (Aminoreban®, Otsuka Pharmaceutical Co., Ltd., Tokyo) and oral antibiotics quickly relieved the symptom and the patient condition had been stabilized thereafter. The anticoagulation therapy was immediately started with Warfarin® aiming at the target level of international normalizing ratio of 2.0. A CT scan taken at 2 months of the anticoagulation treatment revealed patent UP of the PV and the proximal SMV (Fig. 1). The previous PV anastomotic site looked patent, however, the splenic confluence of the PV was completely thrombosed and several collateral vessels including the right gonadal vein (RGV) draining into the inferior vena cava (IVC) were also recognized, for which further anticoagulation therapy or radiological interventions were not no more indicated and surgical intervention was indicated. The ammonia level immediately before relaparotomy was 231 $\mu\text{g}/\text{dl}$ without apparent encephalopathy.

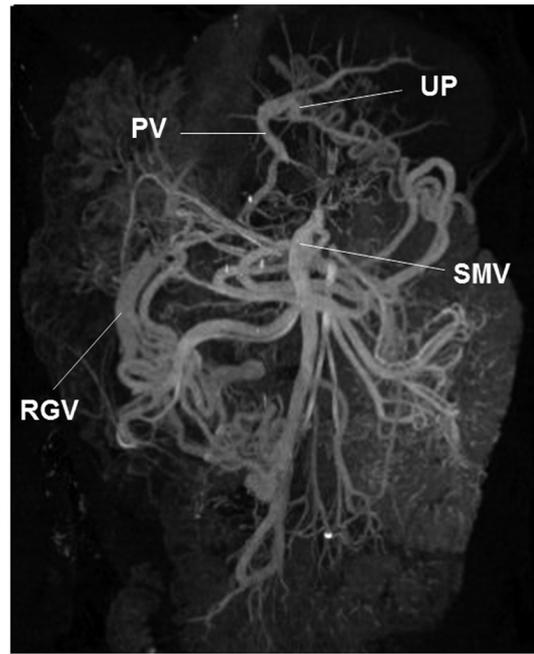


Fig. 1 A CT-scan after 2-months of anticoagulation therapy. Note the PV trunk was completely thrombosed but the UP and the SMV was patent.
RGV, right gonadal vein ; PV, portal vein ; SMV, superior mesenteric vein ; UP, umbilical portion

A Rex shunt was therefore created at 2 months after LDLT. The 8 centimeter-long left inferior jugular vein (LIJV) was procured under the previous collar incision for hemithyroidectomy. The abdomen was entered through the previous scar and the round ligament was identified. The SMV was exposed at the infrapancreatic region and controlled with a tape by ligating or taping tributary veins. Then the Rex recessus of the LL graft was approached with the round ligament being stretched ventrally. The connective tissue sheath on the UP was dissected and controlled with special care not to injure any PV branches derived from the UP, such as the P4, 3 and 2. A tunnel connecting the exposed SMV and the UP was made via an antepancreatic retro pyloric route. The required length of the venous conduit was estimated to be at least 10cm, for which the procured LIJV itself revealed to be too short. The ascending colon was mobilized to the left and the RGV was dissected and procured as an additional 5cm-long venous graft. The LIJV graft was



Fig. 2 Schematic demonstration of the Rex shunt. The Rex shunt was created via antepancreatic retropyloric route using the autologous LIJV and GV grafts.
LIJV, left inferior jugular vein ; GV, gonadal vein.

anastomosed end-to-side to the SMV with 7-0 PDS continuous sutures. There was small amount of intraluminal organized thrombus in the SMV, which was removed as much as possible before anastomosis. Separately, the RGV graft was anastomosed end-to-side to the UP with continuous 7-0 PDS-II® (Ethicon, NJ sutures. Finally the two venous grafts were anastomosed end-to-end with 7-0 PDS continuous sutures with a growth factor and the reconstructed conduit was reperfused (Fig. 2). The sufficient hepatopetal portal flow was confirmed by intraoperative color Doppler ultrasound and electromagnetic flow meter revealed a good hepatopetal flow (450 ml/min) for the conduit. The postoperative anticoagulation drugs were not administered. An ammonia level quickly returned to normal at the evening of 2POD (40 µg/dl), when the Doppler signal in the conduit became undetectable. A graft thrombectomy was performed immediately, which revealed very weak inflow from the SMV. Therefore, one of the patent portosystemic collateral veins was identified and ligated, which resulted in a sufficient inflow from the SMV. The

patient was thereafter on heparin (target APTT, 60s) followed by Warfarin. The patient recovered the procedures and the Rex shunt was confirmed to be patent for 8 months after the procedures.

Discussion

There are basically three treatment options for late PVT after LT, including surgical or radiological interventions and retransplantation. Radiological intervention including percutaneous transluminal angioplasty has reported to be effective in some acute cases with PVT where the guide wire can pass the PV anastomosis⁹. However, in patients with late PVT with complete occlusion of the PV lumen, such intervention is not indicated while surgical reestablishment of the PV flow is the only option for cure. This poses a particular challenge for transplant surgeons due to a lack of appropriate vascular graft for a shunt, especially in countries where cadaveric vascular grafts are hardly available. As well, direct approach to the hepatic hilum is extremely difficult due to adhesion and the location of the PV.

A patient who has a graft with the Rex recess and the LPV (UP) such as whole liver graft and left-sided graft including left lateral segment graft can be a candidate for the Rex shunt. Therefore, confirmation of the patency of the UP and the infrapancreatic SMV is a crucial matter for success. In some cases with PVT, the UP becomes completely thrombosed or atrophic. In such cases, the Rex shunt should not be indicated.

In adult patients, the availability of a long vascular graft is a critical issue. In general, at least 10cm-long graft is necessary to obtain a tension-free anastomosis between the infrapancreatic SMV and UP of the PV through the prepancreatic-retropyloric route. The diameter of the IJV graft is ideal for PV reconstruction but it is usually 6-8cm in length, which is not long enough to use as a single graft¹⁰. Other options are to use the left external iliac vein or the left superior femoral vein, however, these are associated with an additional incision and transient edema of the

lower extremities. In the present case, we utilized the RGV which was enlarged to drain into the inferior vena cava as a collateral vessel (Fig. 2).

The angle of the end-to-side anastomosis between the vein graft and the UP is troublesome. The Rex recess is usually in an upright position during anastomosis, however, it would bent caudally when the LL of the graft is in natural position. Therefore, a wide oblique anastomosis such as "cobra-head" appearance as depicted in Fig. 2 might be effective to avoid kinking. In fact, we confirmed a nice curve of the vascular graft during relaparotomy, although the vascular graft itself was thrombosed due to insufficient inflow and lack of anticoagulation.

Another drawback of this procedure is the limitation of the type of the liver graft. This cannot be applied to PVT in a right lobe graft, which is the most predominantly used for adult patients in LDLT or split LT.

In conclusion, the Rex shunt using the autologous vein grafts can be a feasible option to treat late PVT after adult LL LDLT. This should be applicable to whole liver LT. With further refinements, this technique should become an alternative to the conventional methods. Nonetheless, wider application of this technique should be warranted to confirm the long term efficacy of this technique.

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(和文抄録)

成人生体肝移植後門脈血栓症に対する Rex シャント術

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肝移植後の門脈血栓症は比較的希な合併症であるが、門脈圧亢進症、グラフトロスにつながる重篤な合併症である。上腸間膜静脈と左門脈臍部間をバイパスするいわゆる「Rex シャント」は小児肝移植における門脈血栓に対する有用な治療オプションであるが、十分な長さのグラフトの確保が難しいため成人例における報告はいまだないのが現状である。本論文では、成人左葉生体肝移植後の門脈血栓症に対して、自身の内頸静脈と卵巣静脈をシャントグラフトとして Rex シャントを施行した一例を報告する。本シャントは術後2日目に閉塞したが、緊急血栓摘出および抗凝固療法を施行により術後8ヶ月の時点において開存中である。自家静脈を用いた Rex シャント術は、成人症例においても生体肝移植後の門脈血栓症の治療法として有用な治療オプションである。