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Porto-Rex Shunt for Left Portal Vein Reconstruction During Right Extended Hepatectomy for Advanced Extrahepatic Biliary Cancer

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Abstract Resection offers the only chance of long-term survival or cure for perihilar cancer, provided R0 resection is achieved with margin-negative status of the remnant liver, bile duct, proximal hepatic artery, and portal vein. End-to-end anastomosis of the portal trunk to the left portal branch is the conventional portal reconstruction in cases of right extended hepatectomy requiring resection of the portal vein bifurcation. This mandatory reconstruction may be challenging due to (1) vessel incongruence, (2) fragility of the left portal branch wall, and more importantly, and (3) the divergent orientation of the two vessels exposing to vascular twisting/kinking. We report here the first two cases of porto-Rex shunt, between the portal vein trunk and the left portal vein in the umbilical fissure during right extended hepatectomy for advanced extrahepatic biliary cancer: one following failed conventional portal reconstruction and one to achieve macroscopically complete resection.

Introduction

Resection offers the only chance of long-term survival or cure for perihilar cancer, provided R0 resection is achieved with margin-negative status of the remnant liver, bile duct, proximal hepatic artery, and portal vein [1]. End-to-end anastomosis of the portal trunk to the left portal branch is the conventional portal reconstruction in cases of right extended hepatectomy requiring resection of the portal vein bifurcation [2]. This mandatory reconstruction may be challenging due to (1) vessel incongruence, (2) fragility of the left portal branch wall, and more importantly, (3) the divergent orientation of the two vessels exposing to vascular twisting/kinking. We report here the first two cases of porto-Rex shunt [3, 4], between the portal vein trunk (PV) and the left portal vein (LPV) in the umbilical fissure during right extended hepatectomy for advanced extrahepatic biliary cancer: one following failed conventional portal reconstruction and one to achieve macroscopically complete resection.

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Cases

Case 1

A 54-year-old female patient was diagnosed with perihilar cancer. On abdominal computed tomography (CT) scan and magnetic resonance imaging (MRI), the tumor (25 mm in diameter) was classified as type 3A from a biliary standpoint. Cross-imaging aided by 3D printing technology

(Synergy 3D med, Tel Aviv, Israel) showed invasion of both the right hepatic artery and the portal vein bifurcation, extending high along the left branch. The multidisciplinary meeting indicated a right extended hepatectomy with resection of the portal bifurcation and reconstruction of the left portal vein. Due to jaundice and a small-for-size future remnant liver, preparation for surgery included percutaneous left external biliary drainage followed by embolization of the right portal vein extended to the S4 portal veins. Six weeks later, planned hepatectomy with en-bloc resection of the portal bifurcation was performed without vascular clamping until portal reconstruction. Doppler ultrasonography (Doppler US) showed immediate thrombosis of two attempts at portal reconstruction. We resorted to a Rex shunt [3–5] between the supra-pancreatic PV and the distal LPV, controlled in the umbilical fissure with an interposed reinforced 8-mm-diameter PTFE graft (Figs. 1, 2). Doppler US showed satisfactory intra-hepatic portal flow. Roux-en-Y biliary-jejunal reconstruction was performed. The remaining left lobe was fixed to the abdominal wall to prevent rotation. The total duration of the PV clamping was 75 min, whereas the hepatic artery was never clamped; total operating time was 544 min. Two units of blood were transfused.

Specimen analysis confirmed the diagnosis of perihilar cholangiocarcinoma with perineural invasion. The resection was R0, and the tumor was classified as pT4 and pT4pN1pM0 according to the International Union Against Cancer and the tumor-node-metastasis staging systems, respectively.

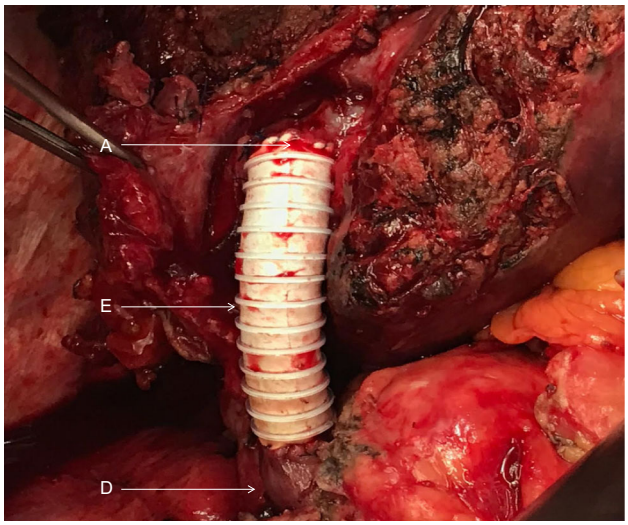

Fig. 2 Intraoperative view of the porto-Rex shunt (A: distal left portal vein in the umbilical fissure following right extended hepatectomy; E: interposed PTFE graft; D: portal vein trunk)

Within 5 days of surgery, lactate and transaminase levels were normal; bilirubin, INR and creatinine were 2.8 mg/dL, 1.32, and 0.42 mg/dL, respectively. Prophylactic low molecular weight heparin was started on post-operative day (POD) 2 and continued throughout hospitalization. A CT scan on POD 5 showed patent portal reconstruction. Massive ascites occurred from POD 1 to POD 12 and then tapered to zero under diuretics. The patient was discharged on POD 30 with normal liver and kidney function and no ascites.

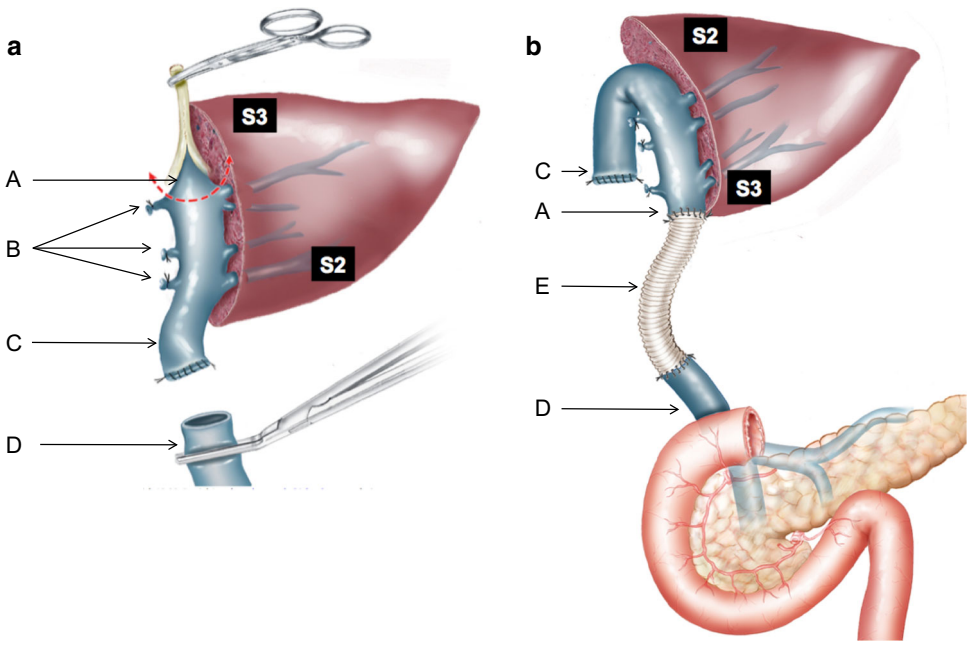

Fig. 1 Schematization of the porto-Rex shunt. **a** Control of the distal left portal vein in the umbilical fissure following right extended hepatectomy. Remaining left lobe lifted upward (A: distal left portal branch in the umbilical fissure; B: ligated branches of segment 4; C: left portal branch stump; D: portal vein trunk); **b** Porto-Rex shunt between the portal vein trunk and the left portal branch with interposed reinforced PTFE prosthesis. E: interposed PTFE graft (8 mm)

Six months after surgery, the patient was well, with patent portal reconstruction visible on CT scan (Fig. 3).

Case 2

A 63-year-old male patient was diagnosed with gallbladder cancer extending to the right pedicle, the hilum and the left portal vein high in the umbilical fissure. Right extended hepatectomy with resection of the biliary confluence was performed following left biliary drainage and right portal vein embolization. To achieve macroscopically complete resection on a portal vein standpoint, a porto-Rex shunt was performed using a 10-mm-diameter PTFE graft. As the porto-Rex shunt was decided upfront, portal clamping lasted only 16 min. Prophylactic low molecular weight heparin was started on POD 1 and continued throughout hospitalization. Postoperative course was uneventful, and the patient was discharged POD 18 with a patent shunt at angio-CT.

Discussion

The Rex shunt, also called mesenterico-portal bypass (from the superior mesenteric vein to left portal vein in the umbilical fissure), was originally proposed in 1992 to treat thrombosis of the PV after pediatric liver transplantation [3]. Its indication was extended to treat idiopathic prehepatic portal hypertension in children with cavernomatous PV thrombosis and a healthy liver [4]. In the present cases, access to the distal LPV in the umbilical fissure was facilitated by the previous right extended hepatectomy. The diameter of the portal vein trunk in adults is usually 12 mm or more. In our first case, an 8 mm PTFE graft was used to maintain a certain degree of portal hypertension and prevent thrombosis of the portal vein reconstruction. This caliber was obviously too small and explains the postoperative massive ascites. In the second case, a 10-mm diameter was used, closer to the portal vein diameter (Fig. 2). This second patient had no postoperative ascites. In view of this experience, we recommend using 10- or 12-mm prosthesis, closer to the usual size of the portal vein in adults."

To our knowledge, the Rex shunt has been used only twice in adults in the postoperative setting to treat complicated portal hypertension due to portal vein thrombosis following a Whipple procedure. These operations used the superior mesenteric vein [6] and the splenic vein [7] as the portal inflow.

Instead of the synthetic graft used in the present case, other types of graft could be used, including autologous vein or a cryopreserved graft. Adapting Dardik's technique [8], Facciuto et al. [9] have described, in children, recanalization of the umbilical vein distally in the round ligament for meso-Rex bypass. This could allow portal reconstruction without an interposed graft by taking advantage of the already connected umbilical vein to perform a single anastomosis and avoiding the morbidity of a vein harvest.

As in the present second case, the Rex shunt option increases the feasibility of macroscopic complete resection in cases of liver tumor requiring right hepatectomy and resection of the portal bifurcation with a distal section of the LPV. The shunt described here could also be an option in pancreatic surgery or hepato-duodenopancreatectomy when resection of the PVT high in the hilum is needed. In cases in which conventional PV reconstruction is anticipated to be difficult or impossible, preparation for a Rex shunt with early control of the distal LPV should decrease the total portal clamping time.

Conclusion

We report here the first two cases of Rex shunt between the portal vein trunk and the left portal vein in the umbilical fissure following failed conventional portal reconstruction or to achieve macroscopically complete resection during right extended hepatectomy for advanced extrahepatic biliary cancer. The porto-Rex shunt might be added to the options for portal reconstruction in complex liver surgeries in adults who require left portal vein reconstruction. The use of graft caliber close to the portal vein caliber, i.e., 12 mm, should be used to prevent prehepatic portal hypertension.

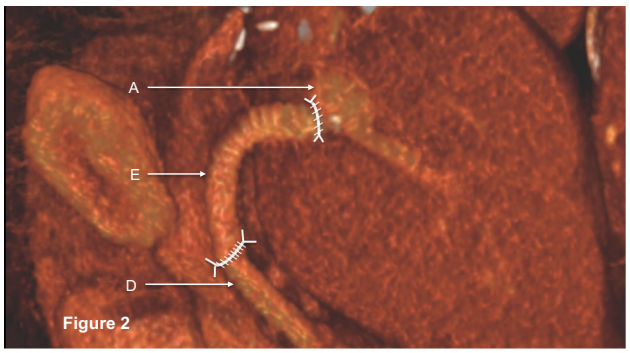

Fig. 3 Computed tomography image of the patent porto-Rex shunt at 6 months

Compliance with ethical standards

Conflict of interest None to declare.

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