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Portal-to-right portal vein bypass for extrahepatic portal vein obstruction☆,☆☆

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ABSTRACT

Objective: Rex shunt (mesenteric-to-left portal vein bypass) is considered a more physiologically rational treatment for EHPVO than other portosystemic systemic shunts in children. However, about 13.6% of children with EHPVO do not have usable left portal veins and up to 28.1%. Rex operations in children are not successful. Hence, a Rex shunt in these children was impossible. This study reports a novel approach by portal-to-right portal vein bypass for treatment of children with failed Rex shunts.
Material and methods: Eight children (age 6.1 years, range 3.5–8.9 years) who underwent Rex shunts developed recurrent gastrointestinal bleeding and hypersplenism 13 months (11–30 months) postoperatively. After ultrasound confirmation of blocked shunt, they underwent exploration. Three patients were found to have right portal vein agenesis. Five patients (62.5%) were found to have the patent right portal vein, with the diameter of 3–6 mm. Four patients underwent bypass between the main portal vein in the hepatoduodenal ligament and the right portal vein by interposing an inferior mesenteric vein autograft, whereas the remaining patient underwent a bypass using ileal mesenteric vein autograft.
Results: The operations took 2.3 h (1.9–3.5 h). The estimated blood loss was 50 ml (30–80 ml), with no complication. The portal venous pressure dropped from 34.6 cmH_2O (28–45 cmH_2O) before the bypass to 19.6 cmH_2O (14–24 cmH_2O) after the bypass. The 5 patients were followed up for 10.2 months (4–17 months) and the postoperative ultrasound and CT angiography confirmed the patency of all the grafts and disappearance of the portal venous cavernova in all five patients.
Conclusion: The portal-to-right portal vein bypass technique is feasible and safe for treatment of children with EHPVO who have had failed Rex shunts. Our preliminary result indicates that this technique extends the success of Rex shunt from left portal vein to right portal vein and open a new indication of physiological shunt for some of the children who not only have had failed Rex shunts or but also are not suitable for the Rex shunts.
Type of study: Treatment study.
Level of evidence: Level IV.

Extrahepatic portal vein obstruction (EHPVO) is the usual cause for portal hypertension in children. A Rex shunt (mesenteric-to-left portal vein bypass) [1] is considered a more physiologically rational treatment for EHPVO in children compared to other portosystemic systemic shunts, as it eliminates the untoward effects of depriving the liver of splanchnic portal flow and significant morbidities, such as encephalopathy [2,3], and currently regarded as an standard procedure for EHPO treatment. However, about 13.6% of children with EHPVO do not have usable left portal veins [4]. In addition, up to 28.1% Rex operations in children are unsuccessful [4,5], meaning a physiological bypass of the EHPVO in these children is not possible. The aim of this study is to report our experience using a portal-to-right portal vein bypass technique for extrahepatic portal vein obstruction (EHPVO) in children with failed Rex shunts.

1. Materials and methods

Between November 2015 and December 2016, eight children (age 6.1 years, range 3.5–8.9 years) who underwent Rex shunts developed recurrent gastrointestinal bleeding and hypersplenism 13 months (11–30 months) postoperatively. The Rex shunting surgeries conducted by using enlarged gastric coronary vein in 6 cases and by the inferior

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mesenteric venograft interposition between the main portal vein and intrahepatic left portal vein in 2 cases. Doppler examination demonstrated EHPVO with permeability of the superior mesenteric vein and failed to confirm patency of original shunting venograft in 8 patients. All patients had gastric varices and hypertensive gastropathy which was ineffective for endoscopic treatment.

They underwent exploration and found to have right portal vein agenesis in three patients and to have patent right portal vein in five patients (62.5%). These five patients were the subjects of the current study. The demographics of the recipients and donors are listed in Table 1.

1.1. Surgical procedure

The original right subcostal laparotomy was extended to the right side for all patients. After the adhesion in the right upper quadrant and hepatic hilum was divided, the right lobe of the liver was mobilized and eversed onto the abdominal wall to allow full exposure of the right portal pedicle and a detailed meticulous dissection. The gallbladder was dissected from the liver surface and the care was taken to avoid to injury the cystic duct and cystic artery. The systic duct was followed onto the common hepatic duct and right portal pedicle to expose the right portal vein, which was dissected out in the right hepatic pedicle from posterior approach (Fig. 1A). All the branches of the right portal vein were isolated carefully. The dissection itself was wide and expose the origin of the left portal vein, the extrahepatic bifurcation of the right portal vein and the caudate lobe behind the portal vein posteriorly. Vein patency and flow were assessed by needle puncture and vein manomitory. It was found that the right intrahepatic portal vein was patent with diameter larger than 3 mm in 5 of the 8 patients and portal-to-right portal vein bypass was further conducted. In the other 3 cases, the right intrahepatic portal vein was agenesis at the liver plate and Warren shunting procedure was performed instead of portal-to-right portal vein bypass. For the 5 patients with right portal vein patency, the peritoneum overlying the hepatoduodenal ligament was opened to allow identification of the enlarged main portal vein, which could be localized either by preoperative imaging examinations (CT angiography, Doppler and MRI) or by intraoperative Doppler and venography. Then, the main portal vein was further dissected to allowed wide exposure and enough room for clamping and performing the lower anastomosis without any difficulty. The care was taken to avoid to injury the common bile duct, which was likely displaced by twisted and enlarged main portal vein in such situation. A small lateral Satinsky clamp allowed good control of the right portal vein and its branches. Its anterior wall was divided and venotomy was extended laterally and medially to achieve enough length for the anastomosis. The venous autografts was harvested from the autologous inferior mesenteric vein in 4 patients and from the ileal mesenteric vein in the other one. The venografts was anastomosed end-to-side first to the right portal vein proximally and then to the main portal vein distally (Fig. 2). By exerting gentle traction on the Satinsky clamp across the right portal vein, exposure to perform the anastomosis was greatly improved. The vein graft was placed posterior to the cystic duct. All vascular anastomoses were performed by a single surgeon using magnification with surgical loupes and interrupted 7–0 monofilament absorbable sutures (polydioxanone).

Postoperative management protocol included administration of low-dose intravenous heparin (100 U/kg per day) for 3 days followed by oral aspirin (7 mg/kg per day if platelet count N50,000/mm^3) and dipyridamole (14 mg/kg per day) for 6 months. Abdominal Doppler ultrasound was obtained in the first 5 postoperative days after the procedure and then at 1, 3, and 6 months postoperatively. Criteria for successful bypass surgery is no recurrence of GI bleeding, bypass patency and disappearance of cavernous transformation.

2. Results

Preoperative Doppler ultrasound and CT angiography in 8 patients demonstrated appearance of cavernous transformation with presence of collateral channels and failed to find patency of original shunting venografts. By direct visualization after careful dissection, the right portal vein was confirmed patency in 5 of those patients and was agenesis on the liver plate in the other 3. In the 5 patients with right portal vein patency, the bypassing procedure was possible to perform between the right portal vein and main portal vein in the hepatoduodenal ligament. The operative time ranged from 1.9 h to 3.5 h (mean 2.3 h) and the estimated bleeding was about 30 ml to 80 ml (50 ml) without necessity for blood transfusion in all cases.

In 5 cases, the right portal vein was 3 mm to 6 mm in diameter with 6–10 cmH_2O in pressure and free of thrombus. Before the creation of the bypass, the pressure of the superior mesenteric vein was found to be 34.6 cmH_2O (28 to 45 cmH_2O). The bypass between the right portal vein and main portal vein in the hepatoduodenal ligament was interposed by inferior mesenteric venous autografts, which was 5 to 10 cm in length and 0.5 to 0.6 cm in diameter in 4 cases, and by ileal mesenteric venograft with 5 cm in length and 0.4 cm in diameter. After creation of the bypass, the pressure of the superior mesenteric vein dropped to values of 19.6 cmH_2O (14 to 24 cmH_2O) (Table 1). There was no intraoperative or postoperative complications and postoperative recovery was uneventful.

Median postoperative follow-up was 10.2 months (4 to 17 months). All 5 children remained asymptomatic with absence of gastrointestinal bleeding and regression of spleen size and hypersplenism during the follow-up study period. In all cases, follow-up Doppler and CT angiography confirmed bypass patency with hepatopetal flow and adequate reperfusion of the liver (Fig. 1C,D). Without exception, the bypass venografts and the branches of intrahepatic portal veins became enlarged in diameter and the cavernoma was rapid regression of flow and disappearance in all patients. Postoperative upper gastrointestinal endoscopy examination showed significant improvement. This study

Table 1
Patient demographics and status at right portal vein bypass.

	Patient A	Patient B	Patient C	Patient D	Patient E
Age at operation (y)	6.1	5.9	8.9	3.5	4.9
Interval after primary operation (months)	13	26	30	15	11
Venograft in primary operation	Gastric coronary vein	Gastric coronary vein	Gastric coronary vein	Gastric coronary vein	Inferior mesenteric vein
Pre-bypass pressure in superior mesenteric vein (cmH_2O)	45	34	32	28	34
Pressure in right portal vein (cmH_2O)	10	6-	10	8	6-
Diameter of right portal vein (mm)	5	3	6	6	3
Venograft types	Inferior mesenteric vein	Inferior mesenteric vein -	Inferior mesenteric vein	Inferior mesenteric vein	Ileal mesenteric vein
Venograft length (cm)	10	8-	5	5	5
Venograft diameter (cm)	0.6	0.6	0.6	0.5	0.4
Post-bypass pressure in superior mesenteric vein (cmH_2O)	24	20-	18	14	22
GI bleeding recurrence	No	No	No	No	No
Follow-up (months)	17	13	9	8	4

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