Percutaneous Transsplenic Stent Placement to Treat Portal Vein Occlusion in a Pediatric Liver Transplant Recipient

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Abstract

In recent years, percutaneous endovascular intervention has become the primary treatment for pediatric post-liver transplantation portal vein stenosis. This procedure is usually performed using a transhepatic approach. Herein, we report the transsplenic endovascular management of a 3-year-old girl with post-liver transplantation, late-onset portal vein occlusion, which occurred after repeated percutaneous transhepatic angioplasty procedures. Transhepatic access was precluded by thrombosis, and we considered an ileocecal approach too invasive; therefore, we performed a portal vein recanalization by puncturing a collector branch of the splenic vein, dilating the portal vein thrombotic stenosis using a balloon, and inserting a self-expanding stent. The majority of percutaneous procedures for portal vein stenosis in children are transhepatic; however, our case demonstrates that transsplenic stent insertion is possible, and should be considered when the transhepatic approach is precluded.

Key words: Liver transplantation, Pediatric, Portal vein, Angioplasty, Transsplenic

Introduction

In recent decades, pediatric living-donor and split-liver transplantation techniques have advanced considerably. For this reason, waiting times for children with end stage liver disease have decreased significantly, as has overall mortality; this has partially alleviated the problem of donor organ scarcity[1, 2]. However, while the number of living-donor transplantations has increased, so has the incidence of portal vein stenosis as a post-transplantation complication. Late-onset (more than 90 days post-operatively) portal vein stenosis occurs after approximately 2% of pediatric, deceased-donor liver transplants, whereas the rate is significantly higher (8%-16%) in living-donor transplants[3, 4].

Balloon dilatation using a transhepatic approach, with or without stent placement, has become the primary treatment for children with portal vein thrombotic stenosis after liver transplantation[5-7]. If the transhepatic approach is precluded by thrombosis, transsplenic or transileocecal approaches are also possible[7, 8]. Herein, we present a case of successful transsplenic angioplasty and stent insertion to treat portal vein thrombotic stenosis in a 3-year-old girl after liver transplantation.

Case Report

A 3-year-old girl (weight: 14 kg, height: 90 cm) developed thrombotic occlusion of the main trunk of the portal vein 2 years after left lateral segment living-donor liver transplantation and six subsequent transhepatic balloon angioplasty procedures. Given the patient’s age and small body...
size, as well as the likelihood of adhesions and the invasive nature of other options (such as an ileocoecal approach or meso-Rex shunting), we decided to perform a portal vein recanalization, under general anesthetic, using a transsplenic approach.

The patient had been receiving long-term warfarin treatment. Upon admission to the hospital, this was discontinued and replaced with a heparin infusion (150 IU per hour), which was ceased 7 hours prior to venous puncture. Under ultrasound and fluoroscopic guidance, a middle collector branch of the splenic vein was punctured using a 21-gauge metallic needle (Hanako Medical, Saitama, Japan). The needle was then replaced with a 4-Fr sheath (Medikit, Tokyo, Japan) over a 0.018-inch Cope Mandril guide wire (Cook Japan, Tokyo, Japan). A 4-Fr multi-hole straight catheter over a 0.035-inch hydrophilic guide wire (Radifocus, Terumo, Tokyo, Japan) was then passed to the confluence of the splenic vein and superior mesenteric vein (SMV). Angiography revealed that the main trunk of the portal vein was occluded, with concomitant dilatation of the left gastric vein (Fig. 1A) and surrounding collateral veins. The 4-Fr straight catheter and 0.035-inch hydrophilic guide wire were passed beyond the occluded segment, and the patent lateral segment of the portal vein was visualized (Fig. 1B). Following an intravenous heparin infusion (1,000 IU), urokinase (60,000 IU over 10 minutes) was regionally administered to the occluded site via the tip of catheter.

The 4-Fr sheath was replaced with a 6-Fr sheath, and the occluded segment was pre-dilated using a 4-mm × 20-mm synergy balloon (Boston Scientific, Tokyo, Japan); angiography showed hepatopetal flow resuming through the portal vein (Fig. 1C). An optimal stent length of 4-5 cm was estimated using a measurement guidewire, while the native portal vein diameter was estimated on the basis of the inner diameter of the portal vein post-pre-dilation, as well as the diameters of the splenic vein and SMV. A self-expanding stent (Wallstent, Boston Scientific, Galway, Ireland) 7 mm in diameter and 47 mm long was selected, because it was slightly larger than the estimated native portal vein diameter. Therefore, the stent would expand to the current diameter of the vessel and could be expected to grow with the patient. Additionally, it had a relatively gentle expansile force, thus minimizing complications. Following a second heparin infusion (500 IU; approximately 50 min after the first heparin infusion), the stent was passed from the umbilical portion of the left portal vein to the main trunk of the portal vein, without any immediate complications.

Post-dilatation was then performed using a 7-mm × 20-mm synergy balloon; angiography revealed adequate stent expansion, decreased stenosis, preservation of hepatopetal flow, and decreased flow through the collateral veins (Fig. 1D). Tract embolization of the splenic puncture site was performed using four 0.035-inch Tornado coils (Cook Japan, Tokyo, Japan) and the push technique. The sheath and catheter were pulled back to deploy each of the four coils along the splenic tract (Fig. 1E).

The pressure gradient across the occlusion site decreased from 17 mmHg before stenting (31 mmHg at the confluence of the splenic vein and SMV, and 14 mmHg at the intrahepatic portal vein) to 1 mmHg after stenting (24 mmHg at the confluence of the splenic vein and SMV, and 23 mmHg at the intrahepatic portal vein). An intravenous heparin infusion (200-250 IU per hour) was continued for 1 week after the procedure. Warfarin was then recommenced, with bridging heparin, and continued for 6 months as ongoing anticoagulation therapy.

A follow-up, contrast-enhanced computed tomography scan 25 months later demonstrated patent patency; Doppler ultrasound the following month confirmed that hepatopetal flow in the portal vein had been preserved. There were no clinical signs or symptoms indicating portal hypertension.

Discussion

In the recent literature, the typical endovascular treatment for pediatric portal vein thrombotic stenosis after liver transplantation has been balloon angioplasty using a transhepatic approach. Stent insertion tends only to be used when stenosis recurs. However, stenosis recurrence rates after angioplasty are high (around 26%) [6, 7], and stent insertion has occasionally been used as a primary treatment[9]. In our patient, several factors increased the complexity of endovascular treatment and the risk of stenosis recurrence: the length of the thrombotic segment (from the confluence of the SMV and splenic vein to the bifurcation into the left and right portal veins, i.e. the entire length of the portal vein), the fact that the transplant came from a living donor, the patient’s small body size, and the history of repeated angioplasty.

Many clinicians are reluctant to use stents in small, young children, mostly because of the potential for size mismatch as the child grows[10]. To minimize this risk, as well as the risk of repeat procedures, we performed balloon angioplasty six times over 18 months to allow the patient to grow before inserting a stent. In the literature, the timing of, and indications for, stent insertion vary widely, as shown in Table 1.

While the optimal timing and indications for stent insertion remain unclear, several case series have presented good long-term results, with low rates of stenosis recurrence for up to 7 years after stent insertion[5-7, 9, 10].

Since the entire length of the portal vein was affected by thrombotic stenosis in our case, we selected a stent diameter slightly larger than the estimated true diameter of the portal vein, based on the inner diameter of the portal vein after angioplasty, as well as the diameters of the splenic vein and SMV. We used a self-expanding stent of this size to allow for some increase in diameter as the patient grows. Other investigators have taken a similar approach: Yabuta et al. used a self-expanding stent whose diameter was approximately 20%-30% larger than that of the non-stenotic portal vein, and the stent used by Ko et al. had a diameter 1-2 mm larger[7, 9].
Interventional radiologists typically favor a transhepatic approach; however, in several published cases this was not possible due to extensive thrombosis and occlusion[7, 8]. For instance, Yabuta et al. described a case of recanalization wherein the stent was inserted through the transileoceleal portal vein; however, occlusion soon recurred. Bertram et al. reported good long-term results (16 month follow-up without recurrence) after transsplenic portal vein local thrombolysis and balloon angioplasty, without stent insertion. We also used the transsplenic approach. However, unlike Bertram et al., we did insert a stent; occlusion has not recurred in more than 2 years of follow-up.

In summary, we have presented a successful case of stent insertion in a child with late-onset portal vein occlusion after living-donor, split-liver transplantation. This treatment course should be considered, particularly in cases of re-
curred stenosis or multiple angioplasty procedures. Our case report presents percutaneous transsplenic angioplasty, local thrombolysis, and stent placement as a possible method for recanalization of late-onset portal vein occlusion when the transhepatic approach is precluded.

Conflict of interest: The authors have no conflicts of interest to declare.

References