Portal venous stent placement for treatment of portal hypertension caused by benign main portal vein stenosis

Hong Shan, Xiang-Sheng Xiao, Ming-Sheng Huang, Qiang Ouyang, Zai-Bo Jiang

INTRODUCTION
Portal venous hypertension is caused by extrahepatic obstruction or stenosis when the portal vein is blocked before blood reaches the liver. Patients with this condition account for 5-10% of all cases of portal hypertension[1-3]. Benign portal venous stenosis or obstruction induced by pancreatitis, appendicitis and postsurgical adhesive portal venous stenosis are the most common extrahepatic portal venous occlusion[4]. Portal hypertension resulted from the occlusion of main portal vein often results in the development of varices in esophagus, stomach, duodenum, small and large bowel, and gastrointestinal bleeding leading to death[4-5]. The development of ascites due to portal hypertension affects the patient’s quality of life. Therefore, it is crucial to restore the blood flow of portal vein and to prevent symptoms of portal hypertension.

To date, little is known about the role of stent placement in the treatment of benign portal venous stenosis or occlusion. The aim of the present study was to retrospectively assess the value of stent placement in the treatment of portal hypertension caused by benign main portal vein stenosis or occlusion.

MATERIALS AND METHODS
Patients
From July 2000 to July 2004, six male patients (mean age, 39.8±14.7 years, range 21-65 years) underwent percutaneous transhepatic stent placement for benign portal vein stenosis or occlusion. The clinical characteristics of these patients are summarized in Table 1. Three cases were associated with procedure of liver transplants for posthepatitic cirrhosis, two cases with necrotizing pancreatitis, and one case with suppurative appendicitis. The diagnosis of portal vein stenosis (five cases) and occlusion (one case) was established by Doppler ultrasound, and confirmed by transhepatic direct portography. Clinical signs or symptoms included gastrointestinal tract bleeding from varices in two patients, gastrointestinal tract bleeding and ascites in two patients, and ascites in two patients.

Stent placement
Informed consent was obtained from all patients prior to all procedures. After local anesthesia was performed with 2% lidocaine, the liver was punctured with fluoroscopic guidance using a 21-G needle (Chiba, COOK) or 18-G percutaneous cholangiographic needle (NPAS-100, COOK). A 7-F sheath was inserted into the portal vein through a guidewire. A 5-F catheter was advanced beyond the stenotic
or occluded lesions. Then portography was performed and portal venous pressure was measured. After 3 000-IU heparin was directly injected into the portal vein, the stenotic or occluded segment was dilated with a 10-mm-diameter balloon catheter. The stents were placed across the lesions because of the persistence of stenotic lesions after repeated dilations. The implanted stents included 5 wallstents with a diameter of 10 mm and a length of 5-8 cm (Wallstent, Boston Scientific) in five patients (patients 1-4 and 6), and a Symphony stent with a diameter of 10 mm and a length of 8 cm (Symphony stent, Boston Scientific) in one patient (patient 5) (Table 1). Then portography and portal venous pressure measurement beyond the lesions were repeated. Finally, gelatin sponge or coins were placed in the liver parenchymal tract via the sheath or catheter to prevent intraperitoneal hemorrhage.

All the patients underwent anticoagulant therapy using fraxiparin 3-5 d after the procedure, followed by warfarin administration for 3 mo unless bleeding occurred.

Follow-up protocol
All the patients were followed up by Doppler ultrasound every month to evaluate the patency and blood flow in the portal vein, stent location and stenosis recurrence. Improvement of clinical symptoms, complications and survival was observed.

Statistical analyses
The data were expressed as mean±SD. The significance of differences in portal venous pressure before and after stent placement was assessed with Student’s t test. P<0.05 was considered statistically significant.

RESULTS
Six stents were successfully implanted in the portal venous lesions of all six patients (Table 1, Figure 1). The mean portal venous pressure decreased significantly from (37.3±4.7) cm H\(_2\)O (1 cm H\(_2\)O = 0.098 kPa) to (18.0±1.9) cm H\(_2\)O (Table 1). There was a significant difference in portal venous pressure before and after stent placement (\(t = 10.52, P<0.001\)).

The clinical signs or symptoms of gastrointestinal tract bleeding, gastroesophageal varices and ascites were eliminated after stent placement in all patients. The follow-up period ranged from 1 to 48 mo (mean 30 mo). During the follow-up period, all patients survived except for patient 4 who died of other complications of liver transplantation 1 mo after stent implantment. The follow-up Doppler ultrasound demonstrated that the portal vein remained patent and blood flow in the portal vein with a stent was good. All stents remained patent, and none required repeat dilation and migration of stents was not observed in all patients during follow-up.

After stent placement, all patients complained of mild abdominal pain at the puncture site. Transient fever (lower than 38 °C) occurred in three patients (patients 1, 3 and 4). These symptoms could be alleviated after symptomatic treatment. There were no other procedure-related and postprocedure complications in all patients.

| Patient no. | Sex  | Age (yr) | Symptoms                        | Etiology                        | Portal venous pressure (cm H\(_2\)O) | Stent style |
|-------------|------|----------|---------------------------------|---------------------------------|-------------------------------------|-------------|
|             |      |          |                                 |                                 | Before stent placement | After stent placement   |             |
| 1           | Male | 33       | Ascites, gastroesophageal varices, hematemesis | Postsurgical of liver transplantation | 45        | 20                  | Wallstent   |
| 2           | Male | 35       | Ascites                         | Postsurgical of liver transplantation | 33        | 18                  | Wallstent   |
| 3           | Male | 21       | Ascites, Melena                 | Necrotizing pancreatitis         | 38        | 20                  | Wallstent   |
| 4           | Male | 65       | Gastroesophageal varices, Melena | Postsurgical of liver transplantation | 35        | 18                  | Wallstent   |
| 5           | Male | 40       | Ascites                         | Necrotizing pancreatitis         | 40        | 15                  | Symphony   |
| 6           | Male | 45       | Gastroesophageal varices, Melena | Suppurative appendicitis         | 33        | 17                  | Wallstent   |

1 cm H\(_2\)O = 0.098 kPa.

![Figure 1](image-url) Development of ascites and hematemesis 1 mo after liver transplantation in a 33-year-old man (A and B) and refractory ascites 4 mo after acute necrotizing pancreatitis in a 40-year-old man (C, D).
DISCUSSION
Etiology of portal vein stenosis or occlusion
Portal vein stenosis or occlusion is associated with neoplastic and non-neoplastic conditions. Malignant portal vein stenosis usually results from portal vein tumor thrombus or compression of neoplasms, accounting for 15-24% of patient with portal venous stenosis or occlusion[16-20]. Non-neoplastic conditions are the most common causes of portal venous stenosis and occlusion. The following factors are associated with benign portal vein stenosis or occlusion: inflammatory diseases such as pancreatitis and appendicitis, which can result in thrombosis or elastic portal vein stenosis[10-12]; portal hypertension resulted from liver cirrhosis during which stasis of blood flow in main portal vein and its branches caused by portal hypertension may result in portal vein stenosis or occlusion due to thrombosis[13,14], and antithrombin antibodies may play a role in the development of portal vein thrombosis in cirrhosis[15]; abdominal surgeries or trauma such as liver transplantation surgery, splenectomy, cholecystectomy[16,17,18]; other conditions such as primary portal vein thrombosis and congenital absence of portal vein[19]. Local portal vein stenosis secondary to fibrosis adhesion is usually associated with the inflammatory factors or abdominal surgery at the region of liver hilum. However, not all portal vein stenoses would cause symptoms related to portal hypertension. Some studies indicated that there is no clinical symptom if the stenosis is less than 50% of the diameter of portal vein. If the stenosis of portal vein was greater than 80% of its diameter, symptoms of portal hypertension (e.g., gastrointestinal bleeding, refractory ascites, and thrombocytopenia) develop and liver failure and transplant recipient liver dysfunction occurs[10,19].

In our series, three patients were associated with liver transplant surgery, and the other three patients were associated with inflammation (necrotizing pancreatitis in two cases and supplicative appendicitis in one case). The stenosis in our series was greater than 50% of the diameter of portal vein and occluded completely in one case. Because the clinical symptoms of portal hypertension in these patients were significant, portal venoplasty or stent placement was necessary to decrease the portal venous pressure.

Clinical value of portal venous stent placement
Portal venous stent placement is useful for most patients with portal vein stenosis or occlusion caused by malignant neoplasms. Yamakado et al[6,21], reported the clinical effectiveness of portal venous stent placement in patients with hepatocellular carcinoma (HCC), pancreatic and biliary neoplasms invading portal vein, and found that portal venous stent placement decreases portal venous blood pressure. The clinical outcomes, however, are quite different depending on the invasion site. When portal venous blood flow is blocked and the splanchic vein is intact, the stents remain patent and portal hypertension symptoms subside. If splanchic vein is involved, stents patency would become worse.

To our knowledge, there are only few case reports about the stent placement for portal hypertension caused by benign portal vein stenosis or occlusion. Funaki et al[20], considered that the first choice of treatment for most patients with benign portal vein stenosis is venoplasty with balloon dilation, and stent placement is important for the elastic and recurrent stenosis to maintain the portal vein blood flow. In their study, intravascular stents were placed in 12 patients with segment hepatic transplants for ‘elastic’ or ‘recurrent’ portal vein stenosis, which remained patent for 5-61 mo (mean time, 46 mo). Cherukuri et al[22], placed stents after thrombolysis in two patients with hepatic transplants and portal vein stenosis and thrombosis, and reported that the portal venous patency is good during follow-up. Some authors considered that the management of thrombolysis after stent placement is crucial and effective for patients with portal vein thrombosis[23,24]. In our series, portal stenosis (n = 5) and occlusion (n = 1) were elastic. Balloon dilation was not enough for these patients, stent implantation was performed for all patients to decrease the portal vein pressure. Our results showed portal venous stent placement was useful in decreasing the portal vein pressure, and all stents remained patent in the follow-up. All patients survived and were asymptomatic except for one case who died of complications of hepatic artery thrombosis and bile leakage related to liver transplant.

Complications of percutaneous transhepatic portal venous stent placement
Abdominal pain at the puncture site is the most common complication of percutaneous transhepatic portal venous stent placement[6,19], which occurred in all cases of our series. Transient fever (lower than 38 °C) occurred in three of six patients. The symptoms of abdominal pain and fever are usually mild and disappear 2–3 d after symptomatic treatments. Complication of liver abscess has been reported[20]. Percutaneous drainage is necessary in these patients. The potential complications of intraperitoneal bleeding, bile injury or biliary bleeding, have been reported in percutaneous portal vein embolization or percutaneous transluminal measurement of portal pressure[25-28]. There were no severe complications in our series.

In conclusion, percutaneous portal vein stent placement for the treatment of portal hypertension caused by benign portal stenosis is safe and effective.

REFERENCES
1 Cohen J, Edelman RR, Chopra S. Portal vein thrombosis: a review. Am J Med 1992; 92: 173-182
2 Witte CL, Brewer ML, Witte MH, Pond GB. Protein manifestations of pylephlebitis: A review of thirty-four patients. Ann Surg 1985; 202: 191-202
3 Sugiuira N, Matsutani S, Ohto M, Ebara M, Yoshikawa M, Yamaguchi T, Okuda K, Miki M. Extrahepatic portal vein obstruction in adults detected by ultrasound with frequent lack of portal hypertension signs. J Gastroenterol Hepatol 1993; 8: 161-167
4 Sarin SK, Agarwal SR. Extrahepatic portal vein obstruction. Semin Liver Dis 2002; 22: 43-58
5 D’Amico G, De Franchis R. Upper digestive bleeding in cirrhosis. Post-therapeutic outcome and prognostic indicators. Hepatology 2003; 38: 599-612
6 Yamakado K, Nakatuka A, Tanaka N, Fujii A, Isaji S, Kawarada Y, Takeda K. Portal venous stent placement in patients with pancreatic and biliary neoplasms invading portal veins and causing portal hypertension: initial experience. Radiology 2001; 220: 150-156
Higaki I, 9 8 1 0

Vujic I.

Tsukamoto T, Hirohashi K, Kubo S, Tanaka H, Hamba H, Shuto T, Higaki I, Takemura S, Kinoshita H. Percutaneous transhepatic metallic stent placement for malignant portal vein stenosis. Hepatogastroenterology 2003; 50: 453-455

8 Tanaka JI, Andoh H, Yoshioka M, Furuya T, Asanuma Y, Koyama K. Palliative treatment with metallic stents for unresectable gallbladder carcinoma involving the portal vein and bile duct. J Hepatobiliary Pancreat Surg 2000; 7: 331-335

9 Hiraki I, Hirohashi K, Kubo S, Tanaka H, Tsukamoto T, Omura T, Kinoshita H. Portal vein stenting to treat portal vein tumor thrombus in hepatocellular carcinoma. Osaka City Med J 2000; 46: 99-104

10 Vujic I. Vascular complications of pancreatitis. Radiol Clin North Am 1989; 27: 81-91

11 Schaible R, Textor J, Decker P, Strunk H, Schild H. Transjugular portal venous stenting in inflammatory extrahepatic portal vein stenosis. Cardiovasc Intervent Radiol 2002; 25: 530-532

12 Maleux G, Vaninbroukx J, Verslype C, Vanbekevoort D, Van Hoostegem P, Nevens F. Pancreatitis-induced extrahepatic portal vein stenosis treated by percutaneous transhepatic stent placement. Cardiovasc Intervent Radiol 2003; 26: 395-397

13 Malkowski P, Pawlak J, Michalowicz B, Szczarban J, Wrobleski T, Leoweska E, Krawczyk M. Thrombolytic treatment of portal venous conduit thrombosis. Endovascular stent for management of posttransplant portal venous conduit thrombosis. Transplantation 2000; 69: 2195-2198

14 Lee SY, Ko GY, Gwon DI, Song HY, Lee SG, Yoon HK, Sung KB. Living donor liver transplantation: complications in donors and interventional management. Radiology 2004; 230: 443-449

15 Amitrano L, Guardascione MA, Brandaccio V, Margaglione M, Manguso F, Iannaccone L, Grandone E, Balzano A. Risk factors and clinical presentation of portal vein thrombosis in patients with liver cirrhosis. J Hepatol 2004; 40: 736-741

16 Mamada Y, Tajiri T, Akimaru K, Yoshida H, Tanai N. Long-term prognosis after arterio-portal embolization for hepatocellular carcinoma. Hepatogastroenterology 2004; 51: 234-236

17 Madoff DC, Hicks ME, Abdalla EK, Morris JS, Vauthey JN. Portal vein embolization with polyvinyl alcohol particles and coils in preparation for major liver resection for hepatobiliary malignancy: safety and effectiveness-study in 26 patients. Radiology 2003; 227: 251-260

18 Azoulay D, Castaing D, Smail A, Adam R, Cailliez V, Laurent A, Lemoine A, Bismuth H. Resection of nonresectable hepatic metastases from colorectal cancer after percutaneous portal vein embolization. Ann Surg 2000; 231: 480-486

19 Fujiy Y, Shimada H, Endo I, Morikawa D, Nagano Y, Miura Y, Tanaka K, Togo S. Risk factors of posthepatectomy liver failure after portal vein embolization. J Hepatobiliary Pancreat Surg 2003; 10: 226-232