Diagnostic and Interventional Imaging (2016) xxx, xxx—xxx

ORIGINAL ARTICLE / *Vascular Imaging*

Outcomes of transjugular intrahepatic portosystemic shunt creation for flow-enabled dissolution of spleno-mesenterico-portal venous thrombosis

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KEYWORDS
Transjugular intrahepatic portosystemic shunt (TIPS);
Portal vein thrombosis (PVT);
Mesenteric venous thrombosis;
Cirrhosis

Abstract
Purpose: To evaluate the outcomes of transjugular intrahepatic portosystemic shunt (TIPS) for flow-enabled clearance of portal (PVT), splenic (SVT) and/or superior mesenteric (MVT) vein thrombosis.
Patients and methods: In this single-center study, 12 patients underwent TIPS using Viatorr covered stent-grafts (W.L. Gore & Associates, Flagstaff, AZ, USA) from 2008—2014 for PVT as a primary ($n = 8$) or secondary ($n = 4$) indication. TIPS were not accompanied by pharmacomechanical clot disruption; rather, shunts served to increase portal blood flow to allow flow-mediated physiologic clot dissolution. Pre- and post-TIPS cross-sectional imaging were used to assess clot location, size, and clearance, defined by resolution (vessel patency with no clot), reduction (decrease in clot size), stability (no change in clot size), or extension (increase in clot size).
Results: The cohort included 5 men and 7 women (median age 63 years, range 45—73 years, median MELD score 15) with 30 non-occlusive and asymptomatic thrombi spanning main or intrahepatic PVT ($n = 15/30$, 50%), SVT ($n = 6/30$, 20%), and MVT ($n = 9/30$, 30%). TIPS were generally created with 10 mm covered stent-grafts; mean final portosystemic pressure gradient was 8 mmHg. At mean 190 days post-TIPS, 58% ($n = 7/12$) had clot resolution, 33% ($n = 4/12$) had clot reduction, and 8% ($n = 1/12$) had stable clot; there were no cases of clot extension. Resolution rate was 67% for PVT (10/15), SVT (4/6), and MVT (6/9). Two of 12 (17%) patients underwent successful liver transplant post-TIPS.

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http://dx.doi.org/10.1016/j.diii.2016.07.005

Please cite this article in press as: Lakhoo J, Gaba RC. Outcomes of transjugular intrahepatic portosystemic shunt creation for flow-enabled dissolution of spleno-mesenterico-portal venous thrombosis. Diagnostic and Interventional Imaging (2016), http://dx.doi.org/10.1016/j.diii.2016.07.005

Conclusion: TIPS prompts dissolution of or decrease in PVT, SVT, and MVT in cirrhotic patients. This may be a useful approach notwithstanding omission of pharmacomechanical methods.

Portal vein thrombosis (PVT) with or without concurrent splenic vein thrombosis (SVT) and/or superior mesenteric vein thrombosis (MVT) occurs in 5—20% of patients with liver cirrhosis [1], and can result in adverse events such as intestinal ischemia and infarction, worsening ascites, portal hypertension with variceal hemorrhage, and portal cholangiopathy [2]. The presence of PVT may also negatively impact liver transplantation outcomes by increasing the technical complexity of the procedure as well as the risk of graft failure and requirement for re-transplantation [3,4]. The principal underlying basis for development of spleno-mesenterico-portal venous thrombosis in the setting of portal hypertension is stagnation of blood flow secondary to hepatic parenchymal disease [5,6]. While systemic anticoagulation is routinely utilized for therapy [7,8] and may result in portal recanalization in one-third of cases [9], it does not improve portal hemodynamics, and its use may be contraindicated in patients with gastroesophageal variceal bleeding risk. By improving portal venous blood flow characteristics, transjugular intrahepatic portosystemic shunt (TIPS) creation may facilitate clearance of spleno-mesenterico-portal venous thrombosis to preserve portal venous patency in cirrhotic patients, with a secondary benefit of applicability in patients with portal hypertensive complications such as varices. This study was undertaken to evaluate the efficacy of TIPS in clearing PVT with or without associated SVT and/or MVT, with the hypothesis that TIPS enables progressive venous patency over time by improving flow dynamics.

Patients and methods

Institutional review board approval is not required for small retrospective case series at the authors' institution. For this type of study, formal consent for participation is not required. Informed consent was obtained for all TIPS procedures.

Patient selection

Cases for this study were accrued from a database of 300 patients who underwent technically successful TIPS procedures at a single tertiary care hospital. Sixteen patients who underwent TIPS for PVT with or without associated SVT and/or MVT as either a primary or secondary TIPS indication between December 2008 and March 2014 were selected for study. A primary indication referred to TIPS pursued to prevent thrombus propagation either due to contraindication to anticoagulation or as bridge to liver transplantation, while a secondary indication denoted TIPS primarily undertaken for bleeding [10] or ascites [11], with prevention of clot growth as ancillary intention. There was no minimum thrombus burden for study inclusion; rather, TIPS creation was pursued with therapeutic intent in patients with PVT, SVT, and/or MVT who would otherwise receive systemic anticoagulation according to accepted clinical guidelines [12]. Patients who lacked cross-sectional imaging follow-up after TIPS ($n = 4$) were excluded from the analysis, yielding a final study cohort of 12 patients. None of the study patients had myeloproliferative diseases or other underlying hypercoagulable states. Of note, the clinical outcomes of a subset (4/12, 33%) of the cohort included herein were previously reported in a separate publication [13].

TIPS procedures

The technique for TIPS creation has been previously described [13]. Briefly, TIPS procedures were performed in the IR suite using general anesthesia. Jugular venous access was gained with a 21-gauge needle (Micropuncture Introducer Set; Cook Medical, Bloomington, IN, USA) and a 10 French sheath (Pinnacle; Terumo Interventional Systems, Somerset, NJ, USA) was introduced. A 5 French catheter (MPA; AngioDynamics, Latham, NY, USA) was used to select a hepatic vein, typically the right. Free and wedged hepatic venography, as well as pressure measurement, was performed using a balloon occlusion catheter (8.5/11.5 mm Berenstein Occlusion Balloon Catheter; Boston Scientific, Natick, MA, USA). Wedged hepatic venography was routinely performed with carbon dioxide, given theoretical advantages of low viscosity for trans-sinusoidal diffusion and filling around PVT, as well as non-nephrotoxicity. Next, a Rösch-Uchida transjugular liver access set (Cook Medical Co., Bloomington, IN, USA) was used to access the portal vein. In general, the right portal vein was targeted for puncture—even in the setting of right portal vein clot—due to relative technical ease of right portal vein puncture versus left portal vein puncture. After portal vein catheterization and pressure measurement, the hepatic parenchymal tract was dilated with a balloon (Mustang; Boston Scientific, Natick, MA, USA). Direct portography was then performed. Subsequently, 8 ($n = 1$) or 10 mm ($n = 11$) Viatorr covered stent-grafts (W.L. Gore & Associates, Flagstaff, AZ, USA) were deployed across the liver tract. Balloon angioplasty was performed using an 8—10 mm balloon (Mustang; Boston Scientific, Natick, MA, USA). A final portosystemic pressure gradient (PSG) was measured, and completion shunt venography was performed. Embolization of gastroesophageal varices was performed at the discretion of the primary IR operator. TIPS were not accompanied by pharmacomechanical clot disruption and clot dissolution techniques, including catheter-directed thrombolysis and mechanical thrombectomy, were not employed. Rather, shunts served

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