CLINICAL STUDY

Pretransplantation Portal Vein Recanalization and Transjugular Intrahepatic Portosystemic Shunt Creation for Chronic Portal Vein Thrombosis: Final Analysis of a 61-Patient Cohort

Bartley Thornburg, MD, Kush Desai, MD, Ryan Hickey, MD, Elias Hohlastos, MD, Laura Kulik, MD, Daniel Ganger, MD, Talia Baker, MD, Michael Abecassis, MD, MBA, Juan C. Caicedo, MD, Daniela Ladner, MD, Jonathan Fryer, MD, Ahsun Riaz, MD, Robert J. Lewandowski, MD, and Riad Salem, MD, MBA

ABSTRACT

Purpose: To report the final analysis of the safety and efficacy of portal vein (PV) recanalization (PVR) and transjugular intrahepatic portosystemic shunt (TIPS) creation (PVR-TIPS) in patients with PV thrombosis (PVT) in need of liver transplantation.

Materials and Methods: Sixty-one patients with cirrhosis and PVT underwent PVR-TIPS to improve transplantation candidacy. Median patient age was 58 years (range, 22–75 y), and median pre-TIPS Model for End-Stage Liver Disease score was 14 (range, 7–42). The most common etiologies of cirrhosis were nonalcoholic fatty liver disease in 18 patients (30%) and hepatitis C in 13 patients (21%). Twenty-seven patients (44%) had partial PVT, and 34 patients (56%) had complete thrombosis. Forty-nine patients (80%) had Yerdel grade 2 PVT, and 12 (20%) had Yerdel grade 3 PVT. Twenty-nine patients (48%) had cavernous transformation of the PV.

Results: PVR-TIPS was technically successful in 60 of 61 patients (98%). PV/TIPS patency was maintained in 55 patients (92%) at a median follow-up of 19.2 months (range, 0–105.9 mo). Recurrent PV/TIPS thrombosis occurred in 5 patients (8%), all of whom initially presented with complete PVT. The most common adverse events were TIPS stenosis in 13 patients (22%) and transient encephalopathy in 11 patients (18%). Twenty-four patients (39%) underwent transplantation, 23 of whom (96%) received an end-to-end anastomosis. There were no cases of recurrent PVT following transplantation, with a median imaging follow-up of 32.5 months (range, 0.4–75.4 mo). Five-year overall survival rate was 82%.

Conclusions: PVR-TIPS is a safe, effective, and durable treatment option for patients with chronic PVT who need liver transplantation.

ABBREVIATIONS

MELD = Model for End-Stage Liver Disease, PV = portal vein, PVR = portal vein recanalization, PVT = portal vein thrombosis, PVR-TIPS = portal vein recanalization with transjugular intrahepatic portosystemic shunt creation, SMV = superior mesenteric vein, TIPS = transjugular intrahepatic portosystemic shunt

From the Department of Radiology, Section of Interventional Radiology (B.T., K.D., R.H., E.H., A.R., R.J.L., R.S.), Northwestern Memorial Hospital, Robert H. Lurie Comprehensive Cancer Center, Chicago, Illinois; Department of Medicine, Division of Hepatology (L.K., D.G.), Northwestern University, Chicago, Illinois; Department of Surgery, Division of Transplantation (T.B., M.A., J.C.C., D.L., J.F., R.S.), Comprehensive Transplant Center, Northwestern University, Chicago, Illinois; Department of Medicine, Division of Hematology and Oncology (R.S.), Robert H. Lurie Comprehensive Cancer Center, Northwestern University, 676 N. St. Clair, Suite 800, Chicago, IL 60611. Received April 4, 2017; final revision received July 27, 2017; accepted August 8, 2017. **Address correspondence to** R.S.; E-mail: rsalem1@nm.org

From the SIR 2017 Annual Meeting.

Figures E1–E6 are available online at *www.jvir.org*.

J Vasc Interv Radiol 2017; ■:1–8

http://dx.doi.org/10.1016/j.jvir.2017.08.005

Portal vein (PV) thrombosis (PVT) occurs in 10%–25% of patients with cirrhosis, contributes to liver decompensation, and can worsen the sequelae of portal hypertension (1,2). In cases of liver transplantation, PVT is associated with increased intraoperative and postoperative morbidity and mortality (3–6). Analysis of the United Network for Organ Sharing registry and the Scientific Registry of Transplant Recipients database has shown PVT to be an independent risk factor for increased 1-year mortality (7,8). For these reasons, PVT remains a relative contraindication to transplantation at many centers. Nonphysiologic portal reconstructions are a contributing factor to the increased morbidity and mortality of patients with PVT who undergo transplantation (9–11), but when an end-to-end anastomosis can be performed, survival is similar to that of patients without PVT (12–16). Therefore, in transplantation candidates with PVT, the goal of treatment is PV recanalization before transplantation, which permits an end-to-end anastomosis.

PV recanalization (PVR) and transjugular intrahepatic portosystemic shunt (TIPS) creation (PVR-TIPS) has been performed in patients with PVT to improve their candidacy for transplantation by providing a patent PV at the time of transplantation (17). The methods have evolved to include transsplenic access (18). The present study is a final analysis of the efficacy and safety of PVR-TIPS in patients with chronic PVT, expanding on earlier work with a larger cohort and longer-term follow-up to provide more mature patency, transplantation, and survival data.

MATERIALS AND METHODS

Patient Selection

This retrospective study was institutional review board–approved and compliant with the Health Insurance Portability and Accountability Act. Patients with PVT in need of liver transplantation were reviewed at a multidisciplinary liver conference attended by transplant surgery, hepatology, and interventional radiology personnel. Between 2009 and 2015, 61 patients with cirrhosis and PVT needed liver transplantation as a result of the sequelae of cirrhosis. However, these patients were at high risk as a result of PVT and therefore had relative contraindications to transplantation. The patients underwent preoperative imaging to demonstrate the extent and degree of thrombosis. Inclusion criteria included (*i*) medical need for transplantation and (*ii*) presence of chronic PVT on preoperative imaging. Exclusion criteria included (*i*) the inability to be listed for transplantation for reasons other than the presence of PVT and (*ii*) complete, chronic portomesenteric thrombosis precluding catheterization of the PV or splenic vein.

Preoperative imaging was obtained to assess (*i*) the degree of thrombosis of the PV, (*ii*) the presence of cavernous transformation, (*iii*) extension into the superior mesenteric vein (SMV) or splenic vein, and (*iv*) anatomy and patency of the splenic vein (**Fig E1** [available online at *www.jvir.org*]). PVT was categorized as partial or complete as well as by the Yerdel grading system, the most commonly used classification system in the surgical literature (grade 1, partial [< 50%] PV thrombus; grade 2, 50%–100% thrombosis of main PV; grade 3, complete thrombosis of PV and proximal SMV; grade 4, complete thrombosis of PV with extension into the distal SMV) (5).

After review of preoperative imaging, a consensus was obtained to attempt PVR-TIPS in these patients to optimize their transplantation status. In patients with a high Model for End-Stage Liver Disease (MELD) score (ie, > 18), the transplantation workup was completed before PVR-TIPS in the event of hepatic decompensation. This study presents data from a large comprehensive transplantation center with expertise in interventional radiology techniques and liver transplantation, with > 1,500 TIPS procedures and > 1,500 liver transplantations performed in the past two decades. Survival data were closed on July 1, 2017.

Baseline Characteristics

Patient demographic data, laboratory test results, and clinical manifestations of cirrhosis are listed in **Table 1**. The most common etiologies of cirrhosis were nonalcoholic fatty liver disease in 18 patients (30%), followed by hepatitis C in 13 patients (21%). Median baseline MELD score was 14 (range, 7–42). PVT was complete (ie, 100% occlusion of PV with or without extension into the splenic vein or SMV) in 35 of 61 patients (57%) and partial (ie, < 100% occlusion of the PV with or without extension in the splenic vein or SMV) in 26 of 61 patients (43%). Thrombus extended into the SMV in 18 patients (30%) and into the splenic vein in 9 patients (15%). By Yerdel classification, 49 patients (80%) had grade 2 PVT and 12 patients (20%) had grade 3 PVT. At the time of PVR-TIPS, 29 patients (48%) had cavernous transformation of the PV. Four patients (7%) had thrombotic disorders.

Procedural Technique

A detailed description of the PVR-TIPS technique has been previously published (19). After a TIPS sheath was positioned in the hepatic vein, ultrasound (US)-guided access was obtained into an intraparenchymal branch of the splenic vein and a sheath was advanced into the main splenic vein. Venography was performed to confirm PVT (**Fig E2** [available online at *www.jvir.org*]), and the thrombosed PV was traversed. Techniques for locating and traversing the PV in the setting of complete PVT and cavernous transformation have been previously discussed (19). If portions of the splenic vein or SMV were also occluded, they were traversed in a similar manner. The catheter was positioned into the left or right PV, and a snare was used as a fluoroscopic target for the TIPS needle (**Fig E3** [available online at *www.jvir.org*]). A wire was advanced through the TIPS needle, grasped with the snare, and withdrawn through the splenic sheath, providing through-and-through