Cardiovasc Intervent Radiol (2014) 37:262–266
DOI 10.1007/s00270-013-0568-4

CASE REPORT

Combined Pharmacomechanical Thrombolysis of Complete Portomesenteric Thrombosis in a Liver Transplant Recipient

Jonathan M. Lorenz · Shelby Bennett · Jay Patel · Thuong G. Van Ha · Brian Funaki

Received: 19 September 2012 / Accepted: 30 December 2012 / Published online: 30 January 2013

Abstract Treatment options for portomesenteric venous thrombosis range from anticoagulation to surgery, depending on chronicity, severity of symptoms, extent of thrombosis, and the availability of local expertise. For acute and subacute cases, a variety of endovascular options have been described in limited published series and case reports, including thrombolysis and mechanical thrombectomy. We report what is to our knowledge the first case in which the Trellis pharmacomechanical thrombolysis device was used successfully to treat complete acute thrombosis of the entire superior mesenteric vein and the entire portal vein with extension into all segmental intrahepatic portal branches in a young adult after liver transplantation. This device, coupled with adjunctive techniques using balloon catheters, facilitated complete restoration of flow, resulting in graft salvage and long-term patency.

Keywords Liver/hepatic · Portal vein · Thrombectomy · Thrombolysis · Thrombosis · Venous intervention

Introduction

Portomesenteric venous thrombosis (PMVT) is an uncommon but potentially serious form of mesenteric ischemia, often presenting insidiously and responding to conservative management with anticoagulation [1]. To our knowledge, long-term studies comparing anticoagulation with endovascular therapies have not been published, and many patients may benefit from aggressive endovascular options such as catheter-directed thrombolysis and mechanical thrombectomy. In particular, PMVT in a liver transplant recipient can have devastating consequences, such as graft loss and interference with options for retransplantation. In extensive cases and in subacute cases presenting after weeks of symptoms, simple catheter-directed thrombolysis may be unsuccessful as the sole endovascular option.

We present what to our knowledge is the first reported case in which the Trellis pharmacomechanical thrombolysis device (Covidien, Mansfield, MA) was used to salvage treatment of complete intra- and extrahepatic portomesenteric thrombosis after failed overnight catheter-directed thrombolysis in a liver transplant recipient.

Case Report

The requirements of the local institutional review board were satisfied. A 26-year-old man, at 4.8 years after living-related right-lobe liver transplant for primary sclerosing cholangitis, presented with a 3- to 4-week history of nausea, vomiting, and vague abdominal pain. He had a history of abdominal surgery related to Crohn disease involving the small and large bowel. He was found to have a serum aspartate transaminase level of 110 U/L and a serum alanine transaminase level of 71 U/L. Contrast-enhanced CT revealed complete thrombosis of the main portal vein (PV) and the intrahepatic portal branches (Fig. 1), complete thrombosis of the superior mesenteric vein (SMV) and partial thrombosis of its branches. A full hematological assessment for hypercoagulable disorders revealed no abnormalities. He was referred to our interventional radiology department for endovascular treatment.

J. M. Lorenz (✉) · S. Bennett · J. Patel · T. G. Van Ha · B. Funaki
Department of Radiology, The University of Chicago Hospital, 5841 S Maryland Avenue, MC2026, Chicago, IL 60637, USA
e-mail: jlorenz@radiology.bsd.uchicago.edu

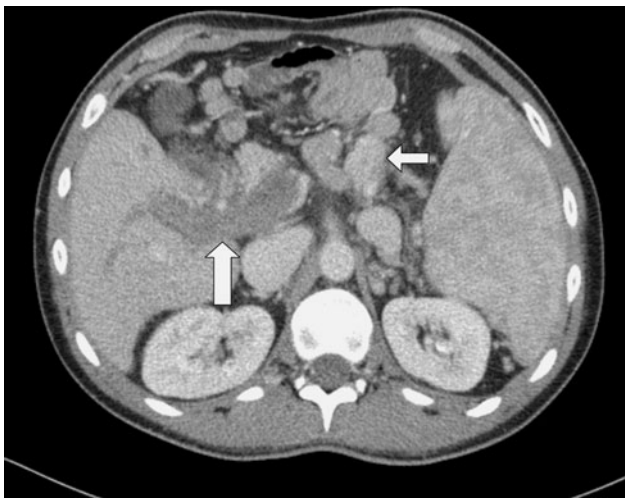

Fig. 1 Contrast-enhanced CT revealed complete thrombosis of the intra- and extrahepatic PV (*large arrow*) and gastric varices (*small arrow*)

Under general anesthesia, a transjugular, intrahepatic approach to the PV was obtained rather than a direct percutaneous transhepatic approach to minimize the risk of intraperitoneal bleeding during thrombolytic therapy. Initially, multiple attempts to access a thrombosed intrahepatic PV branch with a Roche-Uchida transjugular intrahepatic portosystemic shunt (TIPS) set (Cook Medical, Bloomington, IN) were unsuccessful. As a result, temporary transhepatic puncture into a thrombosed PV branch was performed percutaneously under ultrasound guidance, a 0.018-inch Platinum Plus guide wire (Boston Scientific, Natick, MA) was advanced to the PV, and this wire was used as a target for PV puncture from the transjugular approach. Access into the SMV was achieved, and venography verified complete PV and SMV thrombosis with retrograde drainage through mesenteric collateral veins. Through a 6F side-arm sheath in the internal jugular vein, a Cragg-McNamara ev3 valved, multi-side-hole infusion catheter (Micro Therapeutics Inc., Irvine, CA) with a 20 cm infusion length, was placed. Side holes extended from the right intrahepatic PV through the SMV. Overnight infusion of recombinant tissue plasminogen activator (r-tPA) was performed at a rate of 0.5 mg/h with concomitant infusion of heparin at 200 U/h through the side-arm sheath.

The next day, repeat venography revealed no progress, evidenced by persistence of complete PMVT with retrograde filling of collateral veins (Fig. 2). The side-arm sheath in the jugular vein was upsized to a long 10F side-arm sheath (Cook), and the infusion catheter was exchanged over a wire for a Trellis pharmacomechanical thrombolysis device with a 15 cm infusion length. The balloons of the device were inflated in the right PV and SMV, and

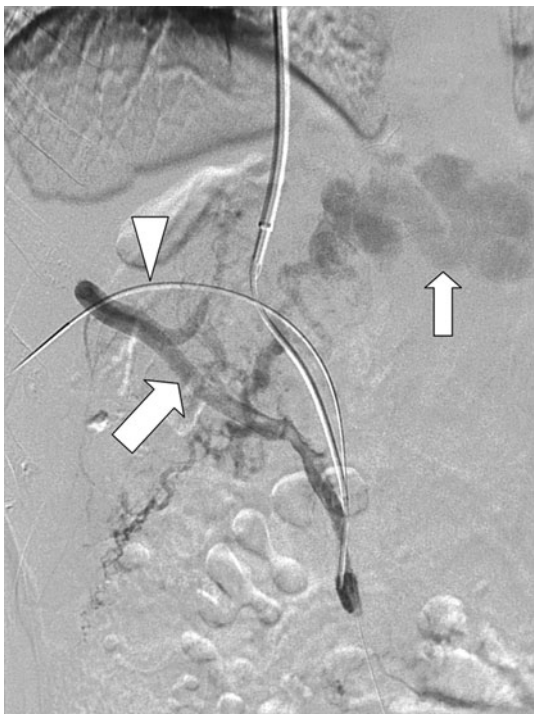

Fig. 2 Transjugular transhepatic contrast injection of the SMV after overnight thrombolysis revealed persistent complete portomesenteric thrombosis with retrograde filling of mesenteric collateral veins (*large arrow*) and large gastric varices (*small arrow*). A 0.018-inch wire (*arrowhead*) was initially placed into the thrombosed portomesenteric system percutaneously by ultrasound guidance to serve as a target for transjugular transhepatic access

motorized rotation of the interposed multisidehole catheter segment was performed during gradual administration of 4 mg r-tPA over a 10 min period. The contents between the balloons were aspirated, the balloons were deflated, and venography was performed through the infusion port of the thrombectomy catheter. The burden of thrombus was greatly reduced, and slow hepatopetal flow was observed in the SMV (Fig. 3). Light inflation of balloon catheters with diameters of 7, 9, and 14 mm (Conquest, Bard, Summit, NJ; XXL, Boston Scientific) was performed from the SMV to the main PV, respectively, and repeat venography revealed improvement in the extrahepatic venous system but persistent partial thrombosis of the intrahepatic system. The jugular sheath was advanced through the liver to the right PV, and maintaining a safety wire in the SMV, catheterization of intrahepatic PV branches was performed. Using a 7 mm × 2 cm balloon catheter (Conquest) and light hand inflation, the clot was pulled retrograde from the intrahepatic segmental branches into the right PV and then aspirated through the sheath. Repeat venography revealed patency of the intrahepatic segments with brisk hepatopetal flow (Fig. 4). The sheath was replaced over a wire for a temporary jugular dual-lumen catheter. The patient was placed on therapeutic IV heparin 4 h after the procedure.

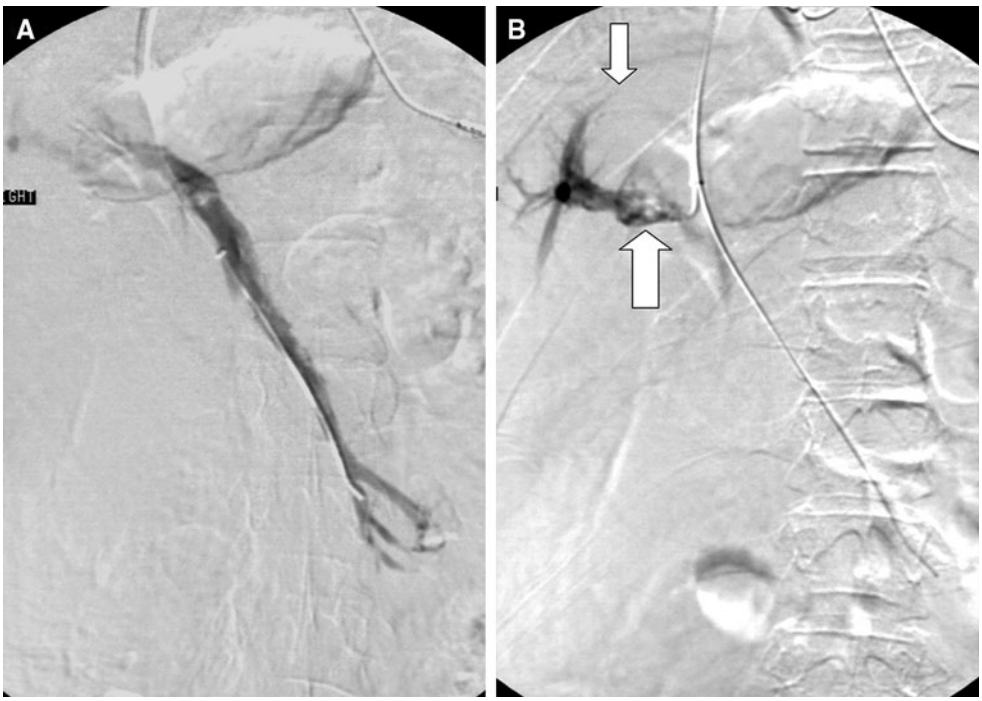

Fig. 3 **a** After treatment with the Trellis device, patency in the SMV was restored and no variceal or collateral venous filling was identified. **b** Pruning of intrahepatic portal branches (*small arrow*) and large clot burden in the right hepatic vein (*large arrow*) persisted

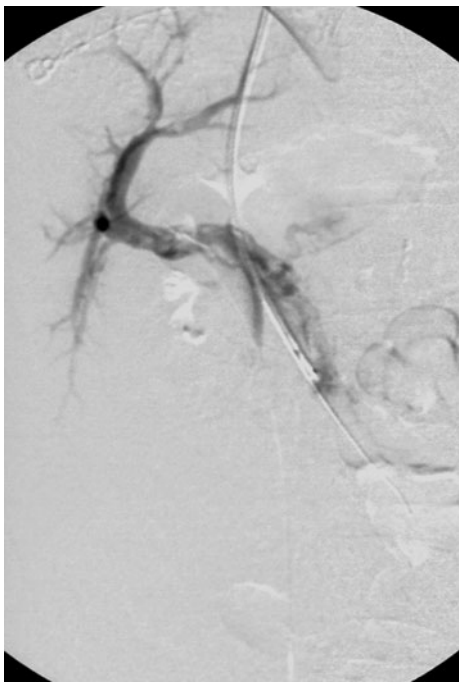

Fig. 4 Clearance of the intrahepatic segmental PVs was accomplished by pulling the clot into the right PV with a balloon catheter and capturing it via aspiration through the sheath, resulting in marked improvement in intrahepatic portal patency

8 h after the procedure, a drop in hemoglobin was noted, and CT revealed a perihepatic hematoma. This was managed to resolution conservatively but initially required IV fluids and 2 U of packed red blood cells. Four days after the procedure, his serum aspartate transaminase and serum alanine transaminase levels had normalized to 39 and 28 U/L, respectively. After stabilization of the hematoma by serial CT, he was transitioned from heparin to Coumadin and discharged 17 days after the procedure. Ultrasound evaluation 16 days after the procedure revealed normal hepatopetal flow within the splenic, superior mesenteric, and PVs without evidence of stenosis (Fig. 5). He has remained asymptomatic for 14 months according to history obtained during regular follow-up clinic visits. Serum liver function tests have remained within normal limits.

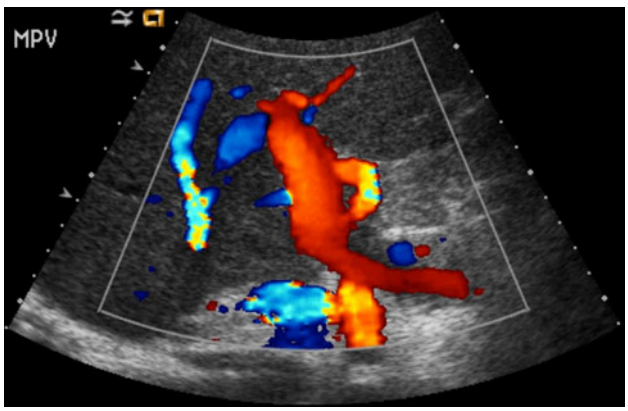

Fig. 5 Wide patency of the portomesenteric system by color Doppler obtained 16 days after intervention

Discussion

Portomesenteric venous thrombosis is a rare but serious vascular complication believed to account for approximately 5 % of cases of acute mesenteric ischemia [1]. In the acute setting, symptoms are variable. If not detected and addressed in a reasonable time, PMVT may lead to bowel necrosis, perforation, and a host of other short- and long-term comorbidities. After liver transplantation, PMVT can have devastating consequences, including graft loss and limitation or loss of future options for retransplantation, particularly in cases involving thrombosis of the SMV. In such cases, the astute clinician may benefit from awareness of both traditional and novel treatment strategies. Published literature describing endovascular mechanical options is limited to only a few case reports and short series.

Predisposing conditions include abdominal surgery; hereditary coagulopathy [2, 3] or an acquired coagulopathy related to conditions such as liver cirrhosis, solid organ, or hematologic malignancy; trauma; infection; or systemic/local inflammation. In our patient, no hematological disorder or PV stenosis related to liver transplantation was discovered, and the etiology was thought to be related to bowel inflammation caused by Crohn disease. One to several days of vague abdominal pain, nausea, vomiting, diarrhea, decreased appetite, and/or hematochezia leads to a high clinical suspicion prompting rapid evaluation with ultrasound and computed tomography. Bowel necrosis may be heralded by a serosanguineous peritoneal effusion [4] progressing to peritoneal signs, leukocytosis, lactic acidosis, and hemodynamic instability.

Conservative management with IV fluids and anticoagulation has been the mainstay for treating PMVT without signs of bowel necrosis. However, as this case illustrates, some of these patients may be candidates for more aggressive endovascular therapies. Acute PMVT is well suited to endovascular management and is typically diagnosed early enough for use of minimally invasive therapeutic options. Treatment strategy depends on chronicity, presentation, and cause, and it begins with hydration, anticoagulation, and correction of precipitating events, followed by consideration of thrombolysis, thrombectomy, or surgery [5]. Surgery is indicated for bowel necrosis, with the goal of salvaging as much viable bowel as possible.

In the published literature, small series and case reports have described a variety of endovascular treatment strategies. In the absence of contraindications and peritoneal signs, thrombolytic agents have been administered by visceral selective catheter directly into the superior mesenteric artery [6] or by infusion catheter directly into the thrombosed vein, either from a percutaneous transhepatic approach or from a transjugular transhepatic approach. Both urokinase and r-tPA with concomitant therapeutic and subtherapeutic intravenous heparin, respectively, have been used, and concomitant papaverine has been infused by arterial catheter in some cases to lessen the effects of arterial spasm on the already tenuous bowel wall. Depending on the clinical presentation, no progress after overnight thrombolysis may prompt long-term anticoagulation therapy, additional nights of thrombolytic infusion, or surgical intervention. Extensive and subacute cases may be prone to not respond to thrombolytic therapy and may require more aggressive strategies.

Limited series and a case reports have described the use of other mechanical thrombectomy devices to treat PMVT. One case report describes successful use of the Trellis device to treat thrombosis of a TIPS with additional involvement limited to the main PV [7]. One retrospective case series found 91.7 % survival after transhepatic catheter-directed thrombectomy with subsequent catheter-directed thrombolysis in 11 patients with acute SMV thrombosis [8]. Mean follow-up was 42 months after percutaneous thrombectomy with the 6F AngioJet rheolytic thrombectomy device (Medrad, Inc, Warrendale, PA) or the Helix Clot Buster thrombectomy device (Microvena Corp., Minneapolis, MN). Scattered published cases report successful clearance of more limited PMVT by using a variety of mechanical thrombectomy devices, including the Amplatz thrombectomy device (Microvena, White Bear Lake, MN), the Arrow-Treratola percutaneous thrombolytic device (Arrow International, Inc., Reading, PA) [9], the Oasis thrombectomy device (Boston Scientific) [10], and the AngioJet device [11]. Successful transhepatic thrombectomy without additional thrombolysis was recently described using an Arrow percutaneous thrombectomy device in a patient with inferior vena cava thrombosis and Budd–Chiari syndrome [12]. Our case demonstrates the therapeutic potential of the Trellis device in a case of complete PMVT that revealed no angiographic improvement after overnight catheter-directed thrombolysis. We found that the 15 cm infusion length appropriately spanned the PV and SMV, and a single 10 min period of motorized rotation and thrombolytic infusion followed by suction thrombectomy through the Trellis aspiration port resulted in marked reduction of clot burden and the development of slow hepatopetal flow. Of note, similar to the results described by Darcy [7], only one session of pharmacomechanical thrombolysis with the Trellis device was required to achieve success in our case, though we first attempted overnight standard catheter-directed thrombolysis.

This case also illustrates the potential for successfully treating complete thrombosis of the SMV and PV, including all intrahepatic branches. Some radiologists may turn away this subset of cases on the basis of an assumption of a limited chance of success and limited literature support to justify the treatment risks. Aggressive use of balloon catheters after thrombolysis and thrombectomy resulted in clearance not only of remnant thrombus in the extrahepatic venous system, but also in the intrahepatic segmental branches. In this 26-year-old liver transplant recipient, aggressive therapy may have prevented the need for a high-risk operation—particularly retransplantation of the liver and, potentially, transplantation of the small bowel. This case also demonstrates that in some cases TIPS may be unnecessary in patients with PMVT. TIPS has been used as an adjunctive therapy after successful endovascular treatment of PMVT [13]. In our young patient with PMVT likely related to Crohn disease, we restored flow with no underlying abnormalities of the transplant graft or portomesenteric venous system. Long-term anticoagulation was chosen as an adjunctive preventive therapy rather than committing him to a lifetime of ultrasound and revision procedures to maintain patency of a TIPS. At the time of this writing, he has remained asymptomatic for 14 months.

Because such extensive PMVT is uncommon, large series validating tools such as the Trellis device and demonstrating the benefits of aggressive endovascular strategies are unlikely to be forthcoming. Published cases like this reveal the value of adjunctive techniques and devices to treat a subset of patients with this potentially serious condition.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Kahn SL, Matsumoto AH (2011) Acute mesenteric ischemia. In: Kandarpa K, Machan L (eds) Handbook of interventional radiologic procedures, 4th edn. Lippincott Williams & Wilkins, Philadelphia, pp 219–232
2. Hugon S, de Clercq P, Landen S (2007) Acute mesenteric vein thrombosis. Ann Emerg Med 50:623–624
3. Famularo G, Minisola G, De Simone C (2008) Mesenteric vein thrombosis. Ann Emerg Med 51:685
4. Abdu RA, Zakhour BJ, Dallis DJ (1987) Mesenteric venous thrombosis—1911 to 1984. Surgery 101:383–388
5. Kumar S, Sarr M, Kamath P (2001) Mesenteric venous thrombosis. N Engl J Med 345:1683–1688
6. Wang MQ, Guo LP, Lin FY et al (2010) Transradial approach for transcatheter selective superior mesenteric artery urokinase infusion therapy in patients with acute extensive portal and superior mesenteric vein thrombosis. Cardiovasc Interv Radiol 33:80–89
7. Darcy M (2007) Single-session treatment of portal vein thrombosis using combined pharmacomechanical thrombolysis. Semin Interv Radiol 24:327–331
8. Kim HS, Patra A, Khan J et al (2005) Transhepatic catheter-directed thrombectomy and thrombolysis of acute superior mesenteric venous thrombosis. J Vasc Interv Radiol 16:1685–1691
9. Semiz-Oysu A, Keussen I, Cwikiel W (2007) Interventional radiologic management of prehepatic obstruction of the splanchnic venous system. Cardiovasc Interv Radiol 30:688–695
10. Takahashi N, Kuroki K, Yanaga K (2005) Percutaneous transhepatic mechanical thrombectomy for acute mesenteric venous thrombosis. J Endovasc Ther 12:508–511
11. Hedayati N, Riha GM, Kouglas P et al (2008) Prognostic factors and treatment outcome in mesenteric venous thrombosis. Vasc Endovasc Surg 42:217–224
12. Haskal Z (2007) Use of the Arrow percutaneous thrombectomy device and transjugular liver biopsy cannula for mechanical thrombectomy of the inferior vena cava in a patient with Budd–Chiari syndrome. J Vasc Interv Radiol 18:924–927
13. Senzalo M, Sartori T, Rossetto V et al (2012) Prospective evaluation of anticoagulation and transjugular intrahepatic portosystemic shunt for the management of portal vein thrombosis in cirrhosis. Liver Int 32:919–927