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Acute Portal Vein Thrombosis: Endovascular Management in Three Different Scenarios

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Abstract

Background: Acute portal vein thrombosis (aPVT) is a severe complication of the splanchnic venous system, often associated with portal hypertension, intestinal ischemia, and hepatic dysfunction. Anticoagulation is the first-line therapy but is frequently insufficient in advanced Yerdel grade III–IV cases, where recanalization rates remain low. Endovascular interventions have emerged as alternative therapeutic strategies in selected patients. Methods: We present three cases of patients with Yerdel grade III–IV aPVT who underwent endovascular management. The techniques included: (1) transhepatic aspiration thrombectomy combined with intra-thrombus thrombolysis using alteplase (Actilyse); (2) combined aspiration thrombectomy, intra-thrombus thrombolysis with alteplase, portal vein stenting, and transjugular intrahepatic portosystemic shunt (TIPS) creation; and (3) transsplenic aspiration thrombectomy followed by angioplasty, stent placement, and TIPS creation in a post-liver transplant patient. Results: All procedures were technically successful, achieving complete or near-complete recanalization of the portal venous system. Restoration of patency in the extrahepatic portal circulation was confirmed, and portal pressures were reduced in the TIPS-assisted case. No major periprocedural complications occurred. Clinical outcomes included preservation of transplant candidacy and graft salvage. Conclusions: Endovascular therapy may be an option in selected patients with acute portal vein thrombosis. Careful patient selection and an individualized technical approach are essential.

Keywords: portal vein thrombosis; aspiration thrombectomy; TIPS; endovascular therapy; liver transplantation

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1. Introduction

Acute portal vein thrombosis (aPVT) is a severe condition of the splanchnic venous system that leads to significant morbidity due to portal hypertension, intestinal ischemia, and hepatic dysfunction. Its etiology is multifactorial, including advanced cirrhosis, hepatocellular carcinoma (HCC), prothrombotic states, and postoperative complications [1,2].

The recommended initial management involves early anticoagulation, with the goal of preventing thrombus extension and increasing the likelihood of venous recanalization [1,3]. However, the efficacy of anticoagulation alone is limited; studies show that complete recanalization occurs in only about 39% of patients after one year, with minimal additional

benefit beyond the first six months [4]. This limitation underscores the role of endovascular intervention in selected patients with advanced disease [5].

The Yerdel classification is widely used to stratify aPVT, especially in the context of liver transplantation [6]. It divides thrombosis into four grades, with grades III–IV associated with low recanalization rates under anticoagulation alone, supporting consideration of endovascular approaches [6–8].

Among the available modalities, percutaneous aspiration thrombectomy has emerged as a promising technique [9,10]. Dedicated systems such as the Indigo Penumbra allow rapid thrombus removal and restoration of portal venous patency. The procedure may be performed through transhepatic, transsplenic, or transjugular (TIPS-associated) approaches, depending on anatomy and clinical context.

In this article, we describe three cases of advanced aPVT (Yerdel grades III–IV) successfully treated with endovascular techniques.

2. Case Series and Materials

We describe three patients with advanced aPVT (Yerdel grades III–IV) who underwent endovascular treatment using the Indigo Lightning® system (Penumbra, Inc., Alameda, CA, USA).

After venous access to the portal system, mechanical aspiration thrombectomy was performed, with adjunctive intrathrombus thrombolysis when indicated. Additional interventions, including angioplasty, stent placement, and/or TIPS creation, were performed according to the clinical scenario.

Case 1—Transhepatic Aspiration Thrombectomy

A 60-year-old male with obesity and no prior comorbidities presented with progressive upper abdominal pain, bloating, and postprandial discomfort over 10 days, without fever, jaundice, or bleeding. Physical examination revealed mild abdominal distension and tenderness, without signs of chronic liver disease. Laboratory evaluation showed elevated gamma-glutamyl transferase with preserved hepatic function (MELD-Na 10, Child-Pugh A6).

Contrast-enhanced CT demonstrated acute thrombosis of the superior mesenteric vein extending into the main and right portal veins, with mild ascites. MRI confirmed underlying chronic hepatopathy and a 4.8 × 3.5 cm hypervascular hepatic lesion (LI-RADS 5), compatible with hepatocellular carcinoma (HCC). Cross-sectional imaging was performed prior to intervention to guide treatment planning.

Given Yerdel grade III aPVT, the patient underwent urgent endovascular therapy via a percutaneous transhepatic approach under ultrasound and fluoroscopic guidance (Figure 1).

After puncture of a peripheral right portal vein branch using an NPAS puncture access system (Cook Medical, Bloomington, IN, USA), a guidewire and a 4 Fr catheter were advanced into the portal venous system, and the tract was sequentially dilated. A 12 Fr Gore DrySeal Flex introducer sheath was then positioned within the main portal vein.

Initial portography confirmed extensive thrombosis involving the superior mesenteric vein, splenic vein, and portal vein, with absence of hepatopetal flow.

A 12 Fr Indigo Lightning aspiration catheter was advanced, and mechanical thrombectomy was performed with multiple aspiration passes across the superior mesenteric vein, spleno-mesenteric confluence, main portal vein, and right portal branch.

Adjunctive intra-thrombus thrombolysis with alteplase (Actilyse) was administered locally to facilitate clot fragmentation and improve aspiration efficiency.

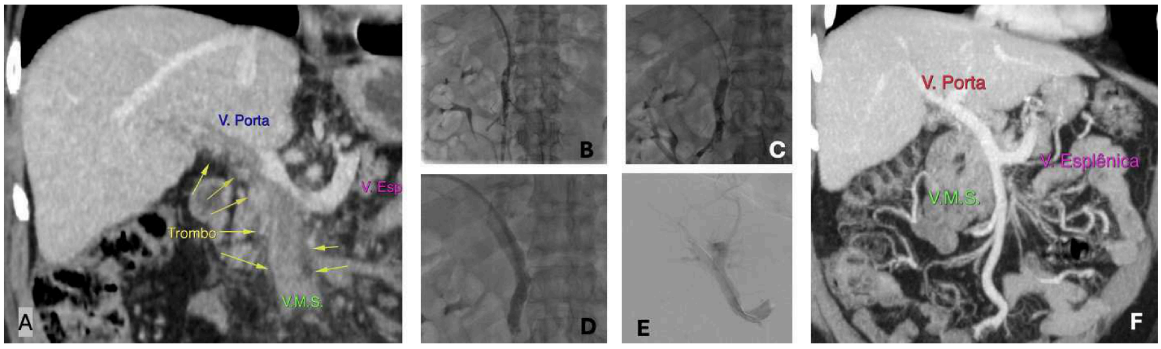


Figure 1. Images from Case 1: (**A**) CT scan showing thrombosis of the Portal Vein, the confluence of the Splenic Vein with the Mesenteric Vein, and the Superior Mesenteric Vein; (**B**–**E**) images from the thrombectomy procedure, Indigo Lightning 12Fr catheter and final angiography; (**F**) follow-up CT scan demonstrating complete recanalization of the Portal, Superior Mesenteric, and Splenic Veins.

Completion angiography demonstrated complete recanalization of the portal, superior mesenteric, and splenic veins, with restoration of portal venous patency and hepatopetal flow.

The transhepatic access tract was embolized using n-butyl cyanoacrylate (Glubran®) to minimize the risk of bleeding.

Following treatment, the patient underwent transarterial chemoembolization (TACE) and was subsequently listed for liver transplantation within Milan criteria. Orthotopic liver transplantation was successfully performed with standard portal anastomosis.

During follow-up, the patient developed a biliary complication requiring retransplantation approximately 6 months later. At more than 4 years of follow-up, he remains clinically stable without vascular complications and ongoing anticoagulation therapy.

Case 2—Thrombectomy Combined with TIPS

A female patient with type 2 diabetes mellitus, systemic arterial hypertension, dyslipidemia, obesity, and coronary artery disease (status post five drug-eluting stents) presented with progressive abdominal distension, ascites, right-sided abdominal pain, and dyspnea on minimal exertion. Her medical history included hepatic steatosis without regular hepatology follow-up.

Contrast-enhanced CT demonstrated features of chronic liver disease with moderate-to-large volume ascites and acute portal vein thrombosis. Cross-sectional imaging was performed prior to intervention.

Pre-procedural laboratory evaluation demonstrated preserved liver function, including a total bilirubin level of 0.8 mg/dL.

Given the severity of portal hypertension and the extent of thrombosis, endovascular intervention was indicated. A transjugular approach was preferred due to the cirrhotic and retracted morphology of the hepatic parenchyma, highly suggestive of portal hypertension, thereby optimizing procedural safety. Intrahepatic puncture was performed using the RUPS-100 system (Cook Medical, Bloomington, IN, USA).

After hepatic vein catheterization, portal venous access was obtained, and a 12 Fr sheath was positioned. Mechanical thrombectomy was performed using a 12 Fr Indigo catheter, followed by intrathrombus thrombolysis with alteplase (30 mg).

Balloon angioplasty of the main portal vein was then performed, followed by placement of a 12 × 40 mm stent. A TIPS was subsequently created using a 6–10 mm × 8 cm Gore Viatorr TIPS Endoprosthesis (W. L. Gore & Associates, Flagstaff, AZ, USA), expanded to 8 mm (Figure 2).

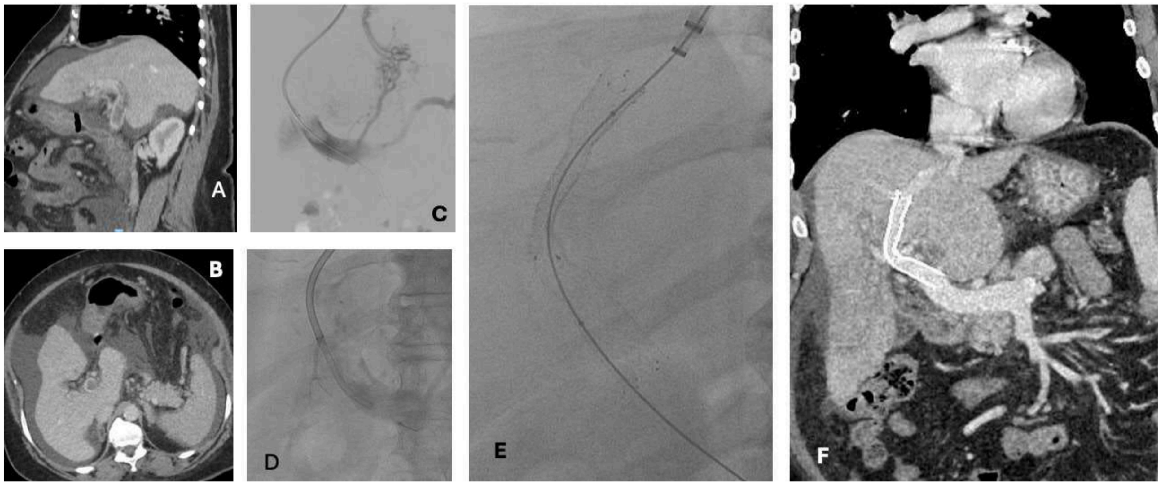


Figure 2. Images from Case 2: (**A**,**B**) CT scan showing thrombosis of the Portal Vein and its right and left branches, cirrhotic liver morphology, and the presence of ascites; (**C**) images from the procedure demonstrating transjugular access; (**D**) thrombectomy using the Indigo Lightning 12Fr catheter; (**E**) final appearance of the TIPS; (**F**) follow-up CT scan demonstrating complete recanalization of the Portal Vein, Superior Mesenteric Vein, and right and left portal branches, with a patent TIPS directing flow toward the right hepatic vein, reduction in splenic size, and resolution of ascites. (TIPS: transjugular intrahepatic portosystemic shunt).

Hemodynamic measurements demonstrated reduction in the portosystemic gradient from 24 mmHg to 11 mmHg.

The procedure was uneventful, and anticoagulation with enoxaparin was initiated.

Following treatment, the patient exhibited resolution of ascites over subsequent weeks. However, further evaluation revealed markedly elevated alpha-fetoprotein levels and a large hepatic mass (~10 cm), later confirmed as hepatocellular carcinoma by biopsy.

Despite initial technical success, the patient developed progressive hepatic decompensation and refractory hepatic encephalopathy, requiring TIPS occlusion. She subsequently experienced progressive liver failure due to progression of neoplasic disease and died approximately 2.5 months after the procedure.

This case highlights the complexity of patient selection, particularly in the setting of advanced liver disease and significant tumor burden, where the indication for TIPS may be controversial.

Case 3—Transsplenic Aspiration Thrombectomy Post-Transplant

A 70-year-old male with cirrhosis due to chronic hepatitis C (with sustained virologic response following prior treatment) underwent liver transplantation after preoperative imaging demonstrated chronic portal vein thrombosis with preserved hepatopetal flow.

In the early postoperative period, the patient developed acute thrombosis of the right portal vein extending to the spleno-mesenteric confluence, with imminent risk of graft dysfunction.

An endovascular salvage approach via transsplenic access was performed under ultrasound guidance using an NPAS puncture access system (Cook Medical, Bloomington, IN, USA).

After puncture of the splenic parenchyma and access to the splenic vein, a guidewire and a 4 Fr Vertebral catheter (Cordis, Miami Lakes, FL, USA) were advanced into the portal venous system, and a 12 Fr Gore DrySeal Flex introducer sheath (W. L. Gore & Associates, AZ, USA) was positioned.

Mechanical thrombectomy was performed using a 12 Fr Indigo catheter. Balloon angioplasty and stent placement were performed across the portal anastomosis and the

splenomesenteric junction. Portal pressure measurement demonstrated a gradient of 22 mmHg. Given this finding, a TIPS was subsequently created to support portal decompression and maintain portal system patency, using a 6–10 mm × 8 cm Gore Viatorr TIPS Endoprosthesis (W. L. Gore & Associates, AZ, USA), expanded to 7 mm. Hemodynamic measurements demonstrated a reduction in the portosystemic gradient from 22 mmHg to 5 mmHg.

Completion angiography demonstrated restoration of patency in the extrahepatic portal venous system. The splenic access tract was embolized using Glubran® to reduce bleeding risk (Figure 3).

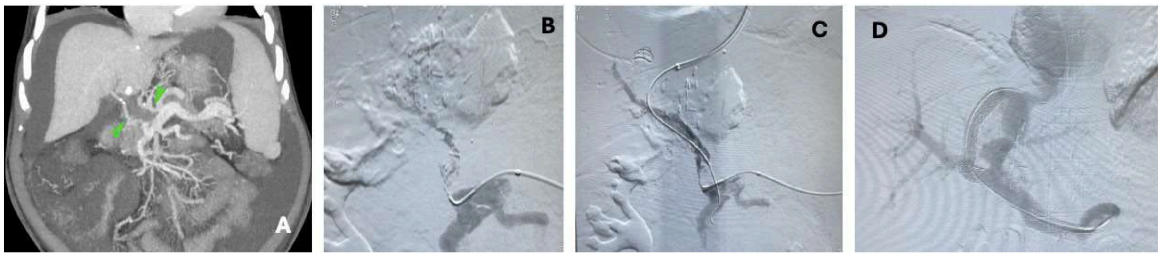


Figure 3. Images from Case 3: (**A**) CT scan showing Portal Vein thrombosis following the transplant anastomosis; (**B**) procedural images demonstrating transsplenic access and Portal Vein thrombosis; (**C**) combined transsplenic and transjugular access followed by thrombectomy using the Indigo Lightning 12Fr catheter; (**D**) final procedural appearance after thrombectomy, demonstrating hepatopetal flow, stent placement in the Portal Vein at the transplant anastomosis site, and the TIPS. (TIPS: transjugular intrahepatic portosystemic shunt).

The patient recovered well, maintaining stable graft function over more than 4 years of follow-up, without recurrence of thrombosis.

It is important to note that TIPS does not increase intrahepatic portal perfusion and may reduce hepatic portal flow, requiring careful consideration in this setting.

3. Discussion

Acute portal vein thrombosis remains a complex clinical condition, particularly in advanced stages and in patients with cirrhosis or liver transplantation. Although anticoagulation is recommended as first-line therapy [3,11–13], its efficacy is limited in extensive thrombosis [5,8,14–17].

Endovascular approaches enable direct thrombus removal and the restoration of portal venous patency [9–11]; however, they are not without risk. The use of large-bore (12 Fr) percutaneous access through hepatic or splenic parenchyma may be associated with significant bleeding complications, particularly in cirrhotic patients or in the presence of coagulopathy. These procedures should therefore be performed in experienced centers with careful patient selection.

The choice of access route should be individualized [9,13,18]. Transhepatic access allows direct portal entry but carries bleeding risk [9,10]. Transjugular access with TIPS enables portal decompression but may be associated with hepatic encephalopathy and reduced hepatic perfusion [1,12,18]. Transsplenic access is an alternative in selected cases but is technically demanding and potentially hazardous [9,10,17].

The indication for TIPS in this context remains controversial. While it may facilitate portal decompression and maintain portal patency [8,18,19], it does not increase intrahepatic portal perfusion and may worsen hepatic function [1,18]. Similarly, in post-transplant patients (Case 3), the use of TIPS should be carefully individualized, especially in cases of persistent portal hypertension after thrombectomy [8,15].

The presence of hepatocellular carcinoma further complicates management and should be systematically assessed prior to intervention with cross-sectional imaging, as it may significantly influence therapeutic decision-making.

4. Conclusions

Acute portal vein thrombosis, particularly in advanced Yerdel grades, represents a challenging clinical scenario. Endovascular therapy may be considered in selected patients when anticoagulation alone is insufficient. Individualized treatment planning, taking into account anatomical, functional, and clinical factors, is essential to optimize outcomes while minimizing risks.

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