

Percutaneous rheolytic mechanical thrombectomy in thrombosed direct intrahepatic portosystemic shunt: Report of two cases

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Abstract: We report two patients with Budd–Chiari syndrome, who underwent direct intrahepatic portosystemic shunt complicated by shunt thrombosis. Percutaneous AngioJet mechanical thrombectomy in combination with manual catheter aspiration and balloon disruption of the residual clot was successful, restoring patency of the thrombosed shunt.

Keywords: Budd–Chiari syndrome, direct intrahepatic portosystemic shunt, thrombosis, thrombolysis, percutaneous mechanical thrombectomy

Introduction

Direct intrahepatic portosystemic shunt (DIPS), performed under intravascular or transabdominal US-guidance and fluoroscopy, has been developed as a modified transjugular intrahepatic portosystemic shunt (TIPS) technique in the case of complete hepatic veins thrombosis [1, 2]. These procedures are associated with a high reintervention rate due to stent thrombosis [3] which can be managed by endovascular means. We report the first application of AngioJet mechanical thrombectomy in combination with manual catheter aspiration and balloon disruption of the residual clot in two patients presenting with thrombosed DIPS.

Case Reports

Patient 1

A 47-year-old female with Budd–Chiari syndrome (BCS) and medical history of polycythemia vera, systemic lupus erythematosus, and antiphospholipid syndrome was referred for transjugular intrahepatic portosystemic shunt (TIPS) due to refractory grade III ascites. The diagnosis of BCS was more than 9 years and initially responded to standard medical treatment (anticoagulation, diuretics).

Hepatic veins were angiographically considered as fully thrombosed. Direct intracaval US-guided punc-

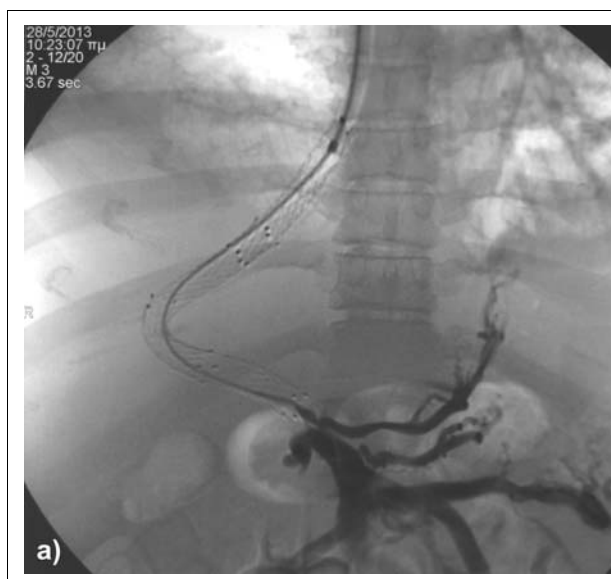


Fig. 1a. Portal vein catheterization reveals a completely thrombosed shunt

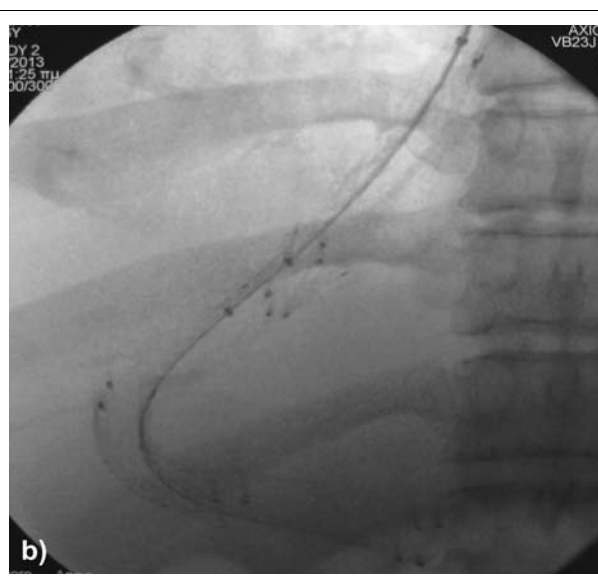


Fig. 1b. Angiojet rheolytic thrombectomy catheter advanced over the wire with multiple passes of the device into the thrombus. The two radiopaque markers on the device show the area of thrombus suction, break up and removal



Fig. 1c. Conclusion angiogram following Angiojet rheolytic thrombectomy with adjunct manual aspiration thrombectomy and thrombus disruption with a partially inflated PTA balloon, shows restoration of a widely patent DIPS shunt

ture (using a convex 4 MHz US-Transducer) from the stenosed intrahepatic IVC segment, through the liver parenchyma using a curved TIPS-Set system (TIPS-set, Cook Medical, USA) towards the portal vein bifurcation, was successfully performed. Two bare self-expanding nitinol stents 10×60 and 10×40 mm (Luminexx, Bard Peripheral Vascular, USA) were deployed with minimal overlap. An additional 10×40 mm covered stent (Fluency, Bard Peripheral Vascular, USA) at the portal hilum level was subsequently deployed due to subcapsular contrast extravasation, which was the reason for delaying anticoagulation. The final result was satisfactory with good shunt flow.

However, the patient did not improve, and 3 days later, color-Duplex revealed shunt thrombosis which was confirmed after shunt catheterization (*Fig. 1a*). Following IV administration of 5000 IU of heparin, the AngioJet rheolytic thrombectomy catheter (DVX type, Possis Medical, USA) was advanced over the wire and multiple slow passes of the device in both antegrade and retrograde manner into the thrombus were performed using a standard catheter aspiration thrombectomy technique (*Fig. 1b*). Adjunct manual aspiration thrombectomy using a standard 8F guiding catheter, followed by thrombus disruption with a partially inflated PTA balloon, was performed due to residual thrombus. Additional balloon

dilatation of the stents followed, establishing complete stent patency (Fig. 1c). Postprocedure the patient developed macroscopic hemoglobinuria that gradually settled. Her clinical condition initially deteriorated with development of renal dysfunction and liver failure; she was aggressively treated as appropriate and enlisted for emergency liver transplantation. Fortunately, the patient gradually recovered, restored appropriate urine output, and ascites and edema subsided significantly. Repeated color-Duplex confirmed patency during the next days

and weeks. Two years after the procedure, the patient is well, without ascites, and has impaired but stable liver function.

Patient 2

A 42-year-old female with a history of BCS on a background of polycythemia vera underwent 11 years ago a successful DIPS procedure – with placement of a semi-

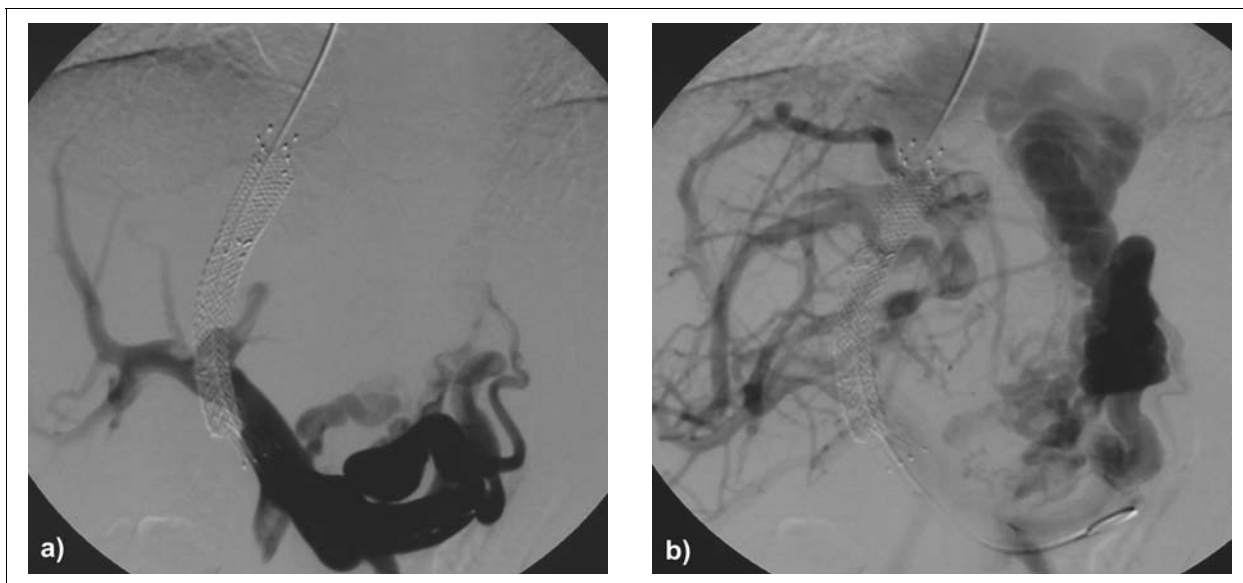


Fig. 2a. Portal angiography shows complete shunt thrombosis probably due to the fractured stent obstacle

Fig. 2b. Severe variceal dilatation in the delayed angiographic images

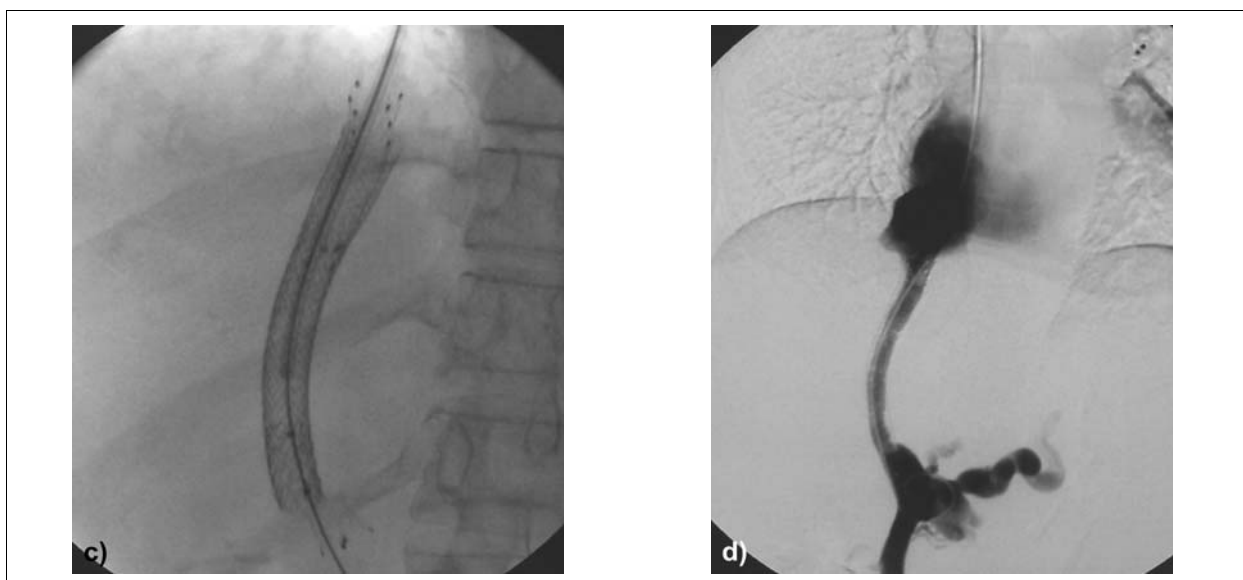


Fig. 2c. Angiojet rheolytic thrombectomy catheter advanced over the wire with multiple passes into the thrombus

Fig. 2d. Conclusion angiogram following Angiojet rheolytic thrombectomy with adjunct thrombus disruption with a partially inflated PTA balloon, additional deployment of 2 nitinol stents and postdilatation, shows restoration of a widely patent DIPS shunt

covered Viatorr stent of 10 mm diameter and 6 cm covered length (Gore, USA) and a 10 × 80 mm Wallstent extension (Boston Sc, USA) up to the IVC. The patient did well for these 11 years; however, 1 year ago she developed new symptoms due to stent dysfunction, so a new 10 × 120 mm Luminexx stent was deployed in another medical centre, with reported restoration of patency. Few months after this procedure, the patient developed acute variceal bleeding and ascites. The varices were banded and commenced on diuretics for ascites. On current admission to our hospital, color-Duplex showed stent occlusion and catheterization of the stent revealed complete shunt thrombosis – probably due to distal stent fracture with slight inner displacement of the broken stent part (*Fig. 2a, b*).

Multiple passes of the Angiojet catheter (DVX type) into the thrombus over a stiff-hydrophilic guidewire were performed using a standard catheter aspiration thrombectomy technique (*Fig. 2c*). The residual thrombus was disrupted with a partially inflated PTA balloon. To reestablish continuation of the stented track, two new 10 × 80 mm and 10 × 60 mm self-expanding Luminexx stents were deployed up to the IVC and postdilated with a 10 × 40 mm balloon. The final angiographic result was satisfactory (*Fig. 2d*). Also, this patient developed macroscopic hemoglobinuria but, nevertheless, recovered well, lost weight without diuretics, and had excellent flow in color-Duplex. She was discharged 1 week later and is now asymptomatic for 20 months.

Discussion

Budd–Chiari syndrome is a less frequent but established indication for TIPS, although can be technically demanding. When retrograde hepatic vein catheterization can be achieved, if the occlusion or the thrombosis is not complete, standard TIPS can be performed. If this is not possible due to complete hepatic vein occlusion, the shunt can be created by direct transcaval puncture [2, 4].

In this context, DIPS is a TIPS modification consisting in puncture of the portal vein directly from the intrahepatic portion of the IVC through the caudate lobe of the liver, using intravascular or transabdominal ultrasound guidance and fluoroscopy. Once this access is obtained, the shunt is created with a bare metal, or preferably a PTFE-covered stent graft, in essence, producing a side-to-side portocaval shunt. This technique has certain advantages over conventional TIPS procedure. It increases the durability of patency of the portosystemic shunt and also increases the spectrum of patients with portal hypertension for whom endovascular portosystemic shunting can be performed [2, 4].

A recognized TIPS–DIPS complication is acute or delayed shunt thrombosis. We hypothesize that, in our

first case, this was the result of the relatively long and tortuous shunt, with multiple stents in it while, in the second case, the acute thrombosis was attributed to the fracture of the distal part of the stent in the portal vein. We do not know in which extent polycythemia vera predisposed to shunt thrombosis. Such cases can be managed by endovascular means including catheter-directed thrombolysis, manual catheter aspiration, and balloon dilatation.

A number of mechanical thrombectomy devices have been used for various indications [5, 6]. To the best of our knowledge, this is the first report of AngioJet application for mechanical thrombectomy of occluded DIPS. The Angiojet device applies the Bernoulli principle of hydrodynamics (moving fluids have an internal pressure inversely proportional to their velocity). When this device is activated, multiple high-velocity, high-pressure saline jets are infused through orifices in the distal tip of the catheter and simultaneously aspirated. This creates a Venturi effect – a localized low-pressure zone that results when a fluid flows through a constricted section of pipe – which emulsifies the clot, converts it into very small particles of 100 µm in diameter or less, and allows it to be removed with the effluent from the catheter. The Angiojet catheters come in several different diameters and lengths which suit for blood vessels of a variety of diameters. This system has the ability to clear a vessel much larger than the catheter diameter compared to other mechanical devices [7]. The device may be used alone, or following pharmacologic thrombolysis or standard catheter aspiration thrombectomy. In our cases, we were reluctant to use catheter directed thrombolysis due the large amount of thrombus in the shunt which would lead to prolonged infusion time and increased risk of bleeding, especially in patients with hepatopathy. We therefore decided to quickly remove the large burden of thrombus with Angiojet catheter followed by adjunct manual catheter aspiration.

The fact that residual thrombus remained adherent to shunt wall even after catheter aspiration, led us to further disrupt it with a partially inflated PTA balloon, with satisfactory results.

One major side effect of the Angiojet is hemolysis. It can cause damage to circulating red cells, manifested as hematuria, hematocrit drop, and even hemodynamic instability. We experienced this adverse event in both patients, who developed transient macroscopic hematuria, which however did not cause any hemodynamic compromise and gradually settled.

In conclusion, AngioJet mechanical thrombectomy can successfully evacuate the large burden of shunt thrombus and, combined with manual catheter aspiration and balloon disruption of the residual clot, seems to be an alternative for minimally invasive recanalization of thrombosed DIPS.

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Conflict of interest: The authors declare no conflict of interest.

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