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Placement of a transjugular intrahepatic portosystemic shunt in addition to recanalization of acute and chronic portomesenteric vein occlusions – a retrospective evaluation

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Abstract

Background: Portomesenteric vein thrombosis may be life-threatening due to bowel ischemia caused by venous stasis, or variceal bleeding caused by portal hypertension.

Purpose: To evaluate the effectiveness and safety of recanalization combined with transjugular intrahepatic portosystemic shunt in acute and chronic portomesenteric vein thrombosis in patients with and without liver cirrhosis.

Material and Methods: 21 consecutive patients (5 women, 16 men; mean 48 years) with portomesenteric vein thrombosis (8 acute, 13 chronic) treated at the Interventional Radiology department between March 2014 and September 2018 were retrospectively reviewed. The main portal vein was completely obliterated and the portomesenteric vein thrombosis extended into the superior mesenteric vein in all patients. The portomesenteric vein thromboses were recanalized transhepatically, a transjugular intrahepatic portosystemic shunt was inserted, thrombectomy was performed in acute portomesenteric vein thrombosis, and angioplasty with or without additional stenting was performed in chronic portomesenteric vein thrombosis.

Results: Recanalization was successful in 8/8 patients (100%) with acute portomesenteric vein thrombosis, and in 11/13 patients (85%) with chronic portomesenteric vein thrombosis. In 12 patients, blood flow was restored in one session. Several sessions were more frequently needed in patients with acute portomesenteric vein thrombosis compared to those with chronic portomesenteric vein thrombosis ($p = 0.003$). Re-occlusion occurred and was recanalized in 10/19 patients and was more frequent in patients with chronic ($n = 8/11$) than on those with acute ($n = 2/8$) portomesenteric vein thrombosis ($p = 0.04$). Adverse events occurred in five patients. There was no 30-day mortality.

Conclusion: Recanalization and insertion of a transjugular intrahepatic portosystemic shunt is safe and effective in patients with acute and chronic portomesenteric vein thrombosis with or without cirrhosis. Recanalization was more likely to stay patent in acute compared with chronic portomesenteric vein thrombosis.

Keywords

Transjugular intrahepatic portosystemic shunt, portomesenteric thrombosis, portomesenteric occlusion, cavernoma

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Introduction

Portal vein thrombosis (PVT) may have severe consequences, especially if it extends into the superior mesenteric vein (SMV). Both acute and chronic portomesenteric vein thromboses (PMVT) may cause acute life-threatening situations due to bowel ischemia caused by venous stasis, or variceal bleeding caused by portal hypertension (PHT).[1]

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The Baveno VI consensus group recommends prompt treatment of acute extrahepatic PVT with systemic anticoagulants, endoscopic therapy, or interventional radiological (IR) procedures.[2,3] In chronic PVT, they state that there is insufficient evidence in favor of IR procedures such as inserting a transjugular intrahepatic portosystemic shunt (TIPS) and performing local thrombolysis.

However, TIPS and local thrombolysis have been proved to be safe and effective in both acute and chronic portal vein occlusion in several small cohorts with[4–9] and without cirrhosis.[10–13] It has also been proved to be superior to endoscopic band ligation and propranolol treatment in preventing re-bleeding from varices.[14,15]

The aim of the present study was to evaluate the effectiveness and safety of recanalization combined with TIPS in acute and chronic PMVT in patients with and without liver cirrhosis.

Material and Methods

Patients and data

After approval from the local ethics board, consecutive patients who had been referred to the Interventional Radiology (IR) department at our hospital for recanalization of acute or chronic PMVT between March 2014 and September 2018 were identified. Those in whom IR recanalization was attempted as primary treatment were included in the present study, i.e. 21 patients (5 women, 16 men) with a mean age of 48 (range 18–74) years. All PMVTs extended into the SMV and many of them into the splenic vein. In eight of the patients, the occlusion was caused by acute thrombus (four of whom had underlying chronic occlusion) and in 13 patients, the occlusion was caused by chronic occlusion with cavernomatous transformation.

The patients were treated according to the Baveno guidelines.[2,3] Recanalization and TIPS was considered when endoscopic or systemic therapy had failed. The decision was taken in a multidisciplinary conference involving experienced hepatologists and interventional radiologists.

The medical records, the radiology information system, all the available computer tomography (CT) images, and the procedural details of the recanalization and TIPS were retrospectively reviewed. Radiation data were missing in four patients, data on the post recanalization portosystemic gradient (PSG) over the TIPS were missing in 10 patients, and data on the final TIPS diameter were missing in three patients. PSG could not be measured before recanalization since the portal vein was completely obliterated.

Primary outcomes were technical success, adverse events, patency, and survival. Secondary outcomes were procedure time, radiation dose, technical parameters, and whether any of these outcomes were determined by whether the PMVT was acute or chronic.

The median follow-up time was two years (SD: one year, five months; range: two months to four years eight months).

Procedure

Patients were under general anesthesia. An ultrasound-guided transhepatic puncture of an intrahepatic portal branch in the right liver lobe was performed and a 5 F catheter was inserted (Gould Catheter, Cook Medical, Bloomington, IN, USA). The PMVT was passed with a soft hydrophilic guide wire (*Glidewire*, Terumo Medical Corp., Somerset, NJ, USA). If needed, a 4 or 5 F sheath was inserted, and an angled catheter was used (*Bolia Mini-Cath,* Terumo Medical Corp., USA, or *Berenstein,* AngioDynamics, Queensbury, NY, USA). Once the PMVT had been passed, the right jugular vein was punctured with ultrasound guidance and a 10 F sheath was inserted. The TIPS procedure was performed using the set from Cook (Rösch-Uchida, Cook Medical, USA) or from Gore (GORE TIPS Set, Gore Medical, W.L. Gore & Associates Inc, Flagstaff, AZ, USA) or a combination of the two. The transhepatically placed guidewire/catheter was used for target for the transjugular puncture. In cases where the right main portal branch was obliterated, a snare was placed in the obliterated branch transhepatically and used for target for the transjugular puncture. Then a Glidewire was advanced through the transjugular puncture into the snare, and the snare was then pushed through the recanalized main portal vein and SMV. A Viatorr stent (Gore Medical, USA) was inserted. In patients with acute thrombus, mechanical thrombectomy was performed through the TIPS using various techniques, i.e. aspiration through a 10 Fr introducer, cleaning with balloons, with Cleaner (Argon Medical Devices, Plano, TX, USA), and/or AngioJet (Boston Scientific, Marlborough, MA, USA) devises. When available, pharmacomechanical thrombectomy was performed where 10–20 mg Alteplase was administered with pulse spray into the thrombus through the AngioJet device 30 min before mechanical thrombectomy. In patients with chronic occlusion, angioplasty was performed, and if patency could not be achieved, the Viatorr stent was prolonged with another Viatorr stent extending into a patent vein. Recanalization was considered successful when free blood flow had been obtained. The transhepatic puncture canal was embolized with a coil. In patients with massive acute PMVT, the 10 F sheath in the right

jugular vein was replaced by a central venous catheter (11.5 F MedComp, Medical Components Inc., Harleysville, PA, USA) to perform a second look after 24 h.

Statistical analysis

SPSS Statistics version 23 (IBM Corp., Armonk, NY, USA) was used for statistical analyses. Comparisons were performed using Pearson's correlation for continuous data, and the Chi^2 test for categorical data. Predictors of re-occlusion were searched for using logistic regression models. The significance level was set at 0.05 in all analyses.

Results

Patient history and symptoms

The patients' symptoms are displayed in Table 1. All the patients with abdominal pain had signs of imminent bowel ischemia on CT.

The etiology of the PMVTs was unrecognized. Of the 21 patients, 9 (43%) were previously healthy and had no risk factors for PVT.[16] In the remaining, the following risk factors could be identified retrospectively: six had had previous abdominal surgery (three of them with mesenteric venous resection), two had been exposed to external abdominal pressure trauma, two had a known liver cirrhosis, one had a previously unknown activated protein C (APC) resistance, and one patient had a previously unknown cirrhosis and a Janus Kinase 2 (JAK 2) mutation.

The 11 patients who presented with variceal bleeding had repeated endoscopic therapy. The eight patients with acute PMVT were primarily treated with systemic anticoagulants. One of the patients with chronic PMVT had been treated with warfarin since the detection of the PMVT, i.e. for four years.

Procedure data

Recanalization was successful obtaining free blood flow in 19 patients (90%), i.e. in 8/8 patients (100%) with acute PMVT, and in 11/13 patients (85%) with chronic PMVT. A snare was needed in the portal vein for target in six patients (all with chronic PMVT). In 12 patients, blood flow was completely restored in one session (Table 2). Several sessions were more frequently needed to restore blood flow in patients with acute PMVT ($n = 6/8$) compared to those with chronic PMVT ($n = 1/11$; $p = 0.003$) (Table 2).

In five patients (three acute PMVT, two chronic PMVT), patency was achieved with one Viatorr stent. In 13 patients (four acute PMVT, nine chronic PMVT), the Viatorr was prolonged with another stent at the primary intervention, in five of these patients (all chronic PMVT) and in one additional patient (acute PMVT), the stents were prolonged after a later re-occlusion had been recanalized. Open mesh stents were used for prolongation in six patients, and covered stents were used in eight patients. The median total stent length was 120 mm (range 70–200 mm). There

Table 1. Symptoms of portomesenteric vein occlusion in 21 patients referred to the Interventional Radiology department for recanalization in relation to whether the occlusion was caused by acute thrombus or chronic occlusion.

Symptoms	Number of patients with acute thrombus (*n*)	Number of patients with chronic occlusion (*n*)	Total number of patients (*n*)
Variceal bleeding	2	9	11
Abdominal pain	6	2	8
Ascites	0	1	1
Progressive splenomegaly	0	1	1

Table 2. Number of sessions required to restore blood flow at primary intervention and the frequency of re-occlusion in 21 patients with acute and chronic portomesenteric vein occlusion.

	Number of patients with acute thrombus ($n = 8$)		Number of patients with chronic occlusion ($n = 13$)	
Number of sessions required to restore blood flow	(*n*)	Occurrence of re-occlusion (*n*)	(*n*)	Occurrence of re-occlusion (*n*)
One session	2	1	10	7
Two sessions	1	1	0	0
Three sessions	4	0	1	1
Four sessions	1	0	0	0

was no correlation between the stent length and whether the PVT was acute or chronic.

The final TIPS diameter was 8 mm ($n = 13$) or 10 mm ($n = 6$). The mean PSG over the TIPS when free flow had been obtained ($n = 11$) was 5 mmHg (range 1–12). Radiation data were registered in 17 patients and are presented in Table 3. There were no differences in radiation dose or fluoroscopy time between patients with acute and chronic PMVT.

Of the eight patients with acute thrombosis, pharmacomechanical thrombectomy was performed in six and mechanical thrombectomy in two. In one of the patients, mechanical thrombectomy was followed by an infusion of 1 mg Alteplase per hour through an indwelling catheter for 36 h.

One of the 13 patients with chronic occlusion had a visible part of the distal main SMV on CT, whereas the remaining 12 had no visible native branches of the SMV on CT. In two of these patients (both women without cirrhosis, 41 and 51 years old), recanalization was not possible. One of them, who had been treated with warfarin for four years, had no clinical symptoms but a progressive splenomegaly. The other had variceal bleeding, which was successfully treated endoscopically with n-butyl-2-cyanoacrylate (Histoacryl®) during the same anesthesia session. Varices and splenorenal shunts were not embolized.

Adverse events

There was no periprocedural or 30-day mortality. There were no bleeding events or pulmonary embolisms. Adverse events occurred in five patients and were not related to sex, the presence of cirrhosis, or whether the PMVT was acute or chronic.

Of these five patients, three experienced easily manageable post procedural pain. One of them got an acute right-sided hemothorax which was successfully treated with coiling of an intercostal artery. This patient had received a total of 50 mg Alteplase through an indwelling catheter. One of the patients had no complications at thrombectomy and TIPS insertion but got an infection in the TIPS 1½ years later after recanalization of a re-occlusion. This patient is still on long-term antibiotics. One of the patients with a known cirrhosis got hepatic encephalopathy (HE) which was easily treated with laxatives.

Patency and mortality

Re-occlusion occurred and was recanalized in 10/19 patients and was more frequent in patients with chronic ($n = 8/11$) than on those with acute ($n = 2/8$) PMVT ($p = 0.04$). (Tables 2 and 4). There was no correlation between the time to re-occlusion and whether the PMVT had been acute or chronic. There was no correlation between the occurrence of re-occlusion and the PSG, the primary stent length or diameter, whether the prolongation stents were covered or open mesh, or whether the patient had any coagulation deficiency. All three patients with cirrhosis had re-occlusion even though two of them had anticoagulation therapy (Table 4).

At follow-up, 18 patients were alive (86%) (Fig. 1). Of the three patients who were deceased, one with an acute post-surgery PMVT died from progressive malignant disease six months after TIPS. The other two had chronic PMVT with extensively obstructed mesenteric veins and rapid re-occlusion of the TIPS. Despite recanalization of the re-occlusions, they died from consequences of PHT at one year and three months and at 10 months after TIPS, respectively. The latter had received the TIPS and thrombectomy as an emergency treatment of a life-threatening variceal bleeding.

Discussion

Complete recanalization was successful in 90% ($n = 19/21$) in the present cohort even though the main portal vein was completely obliterated, and the occlusion extended into the SMV in all patients. Other studies in non-cirrhotic patients report complete recanalization in 35–100%,[10,11,13] in chronic PVT and in 53%[12] in acute PVT. Studies in cirrhotic patients report successful recanalization in 57–84% ($n = 43/51$) in chronic and in 96% in acute PVT.[15]

One study including both acute and chronic PVT reports a greater success rate in acute (91%; $n = 10/11$) than in chronic PVT (75%; $n = 3/4$).[7] This is consistent with the results of the present study, where the success rate was 100% ($n = 8/8$) in acute and 85%

Table 3. Accumulated radiation data from all sessions performed in patients with acute and chronic portomesenteric vein occlusion.

Radiation parameter	Median (range) in patients with acute thrombus ($n = 6$)	Median (range) in patients with chronic occlusion ($n = 11$)
Dose area product (μGym^2)	17,610 (1386–17,673)	24,077 (1880–87,384)
Skin dose (mGy)	1826 (52–7106)	1721 (112–4865)
Fluoroscopy time (min)	111 (25–1788)	96 (20–1788)

Table 4. List of patients in whom re-occlusion occurred.

Pat no.	PMV occlusion	Etiology of PMV occlusion	PSG (mmHg)	Stent length (mm)	Time to recanalized re-occlusion				Alive at follow-up
					First	Second	Third	Fourth	
13	Chronic	Previously healthy	2	80	4 m	–	–	–	Yes
15	Chronic	Previously healthy	1	80	2 m	4 m	–	–	Yes
1	Chronic	Pancreatitis	12	170	1 y	4 y	–	–	Yes
2	Chronic	Pancreatitis	8	120	1½ y	1 y 7 m	2½ y	4 y	Yes
12	Chronic	External pressure	–	100	2½ m	–	–	–	No
14	Acute	Venous resection	–	130	2 m	–	–	–	No
16	Chronic	Venous resection	6	200	20 d	9 m	10 m	–	No
5	Chronic	Cirrhosis	6	160	1 y	–	–	–	Yes
7	Acute	Cirrhosis	10	80	2½ y	–	–	–	Yes
10	Chronic	Cirrhosis	5	120	1½ y	–	–	–	Yes

PMV: portomesenteric vein; PSG: portosystemic gradient; y: years; m: months; d: days.

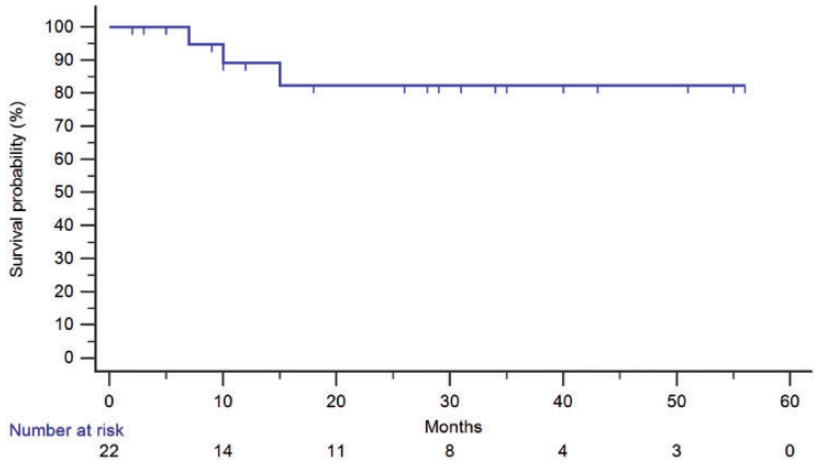

Fig. 1. Kaplan–Meier graph demonstrating survival in 21 patients with acute and chronic portomesenteric vein occlusion treated with recanalization and insertion of a transjugular intrahepatic portosystemic shunt (TIPS).

($n = 11/13$) in chronic PVT. Even though this difference was not statistically significant, the observation corresponds with the experience of the performing IRs that recanalization was less challenging in acute PMVT than it was in chronic.

Despite that, radiation dose and fluoroscopy time did not differ between acute and chronic PMVT. This probably reflects the fact that more sessions were more frequently needed to restore blood flow in patients with acute than in those with chronic PMVT. This might be explained by the following hypothesis: when the thrombus is removed from the main venous branches, the restored blood flow allows thrombus from smaller veins to be mobilized. This may cause re-occlusion of the main branches necessitating renewed thrombectomy. Thus, it may be useful to perform a second look after 24 h in patients with massive acute PMVT.

Thrombectomy was performed through the TIPS which provides a safe access to the portomesenteric system. Despite opening this route to the thrombosed area, there were no signs of pulmonary embolism. Overall, adverse events were rare and there was no procedure-related mortality. Others report a 30-day mortality between 0%[10,11] in non-cirrhotic and 15% in cirrhotic patients.[7] It has been suggested that the risk of HE increases with a low post TIPS PSG.[17] Despite a low mean PSG in the present study, only one patient developed encephalopathy and that patient did not have a low PSG (i.e. 10 mmHg).

In the present cohort, re-occlusion of the TIPS occurred in 50%, compared to 21–60%[5,6,8,10,11,13,14] in other cohorts. Even though chronic PMVTs were more frequently completely recanalized in one session in the present study, they were more prone to re-occlude than acute PMVTs (Table 2). This is probably explained by the fact that the patients with chronic PMVTs more frequently displayed an impaired venous inflow (Fig. 2), since 12/13 had no visible

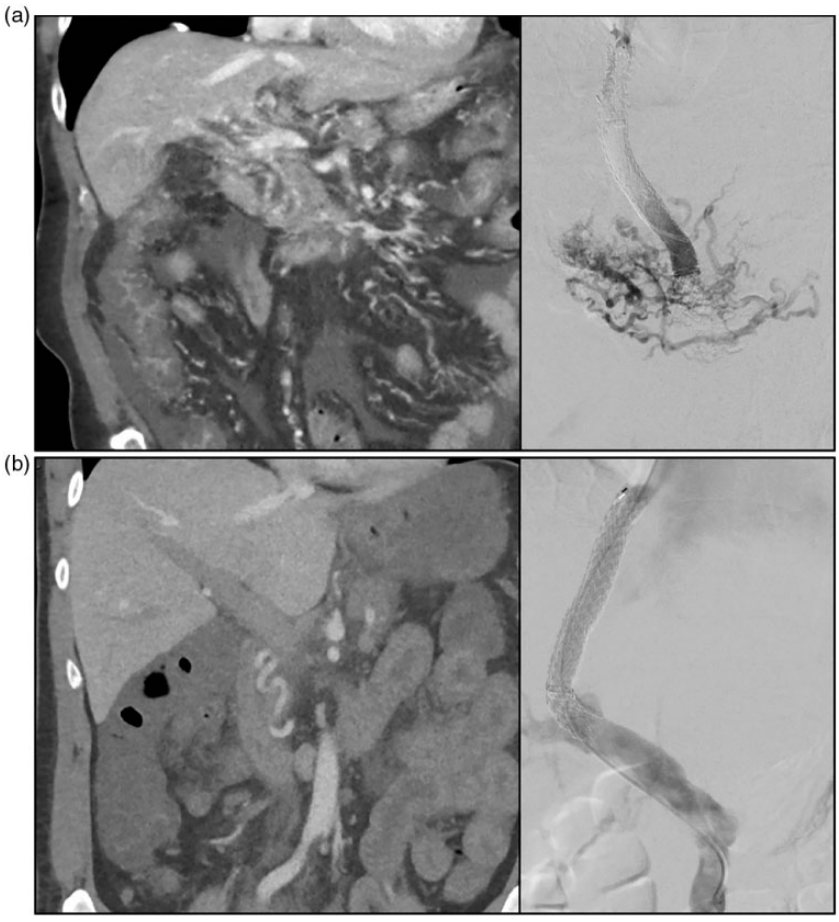

Fig. 2. Preoperative computer tomography (CT) and periprocedural portography images of a patient in whom reocclusion occurred (a), and of another patient with subsequent good patency (b), demonstrating the importance of venous inflow to the transjugular intrahepatic portosystemic shunt (TIPS).

native branches of the SMV on CT prior to recanalization and TIPS.

The results of the present study support the necessity of placing a TIPS to maintain portal flow after PVT recanalization also in patients without cirrhosis.[10,11,13,18] Anticoagulant therapy to optimize the inflow is crucial to ensure TIPS patency.[19,20] Variceal bleeding should not be considered a major contraindication, since anticoagulant therapy will keep the TIPS patent and thereby decrease the PHT and the risk of variceal bleeding.

Even though 12 of the patients with chronic PMVT had no visible native branches of the SMV on CT, recanalization was successful in 10 of them. This indicates that recanalization may be possible even if it does not look feasible on contrast-enhanced CT.

Systemic treatment has been reported to attain recanalization in 30% ($n = 25/83$) of non-cirrhotic patients with acute PVT, observing a completely patent portal venous system in 20%, and the development of cavernomas in 40% after one year.[21] In consistence, one patient in the present study, who had been treated with warfarin for four years for a PVT, had a severe cavernoma where recanalization was not possible.

The observations in the present study that recanalization was less challenging to perform and more likely to stay patent in acute compared with chronic PMVT suggests that it is preferable to perform recanalization and TIPS insertion before the PVT progresses from acute to chronic. Thus, in patients with systemically treated acute PVTs, frequent CT scans may be needed to detect non-responders who may need a TIPS to prevent future PHT due to cavernomatous transformation. Future studies are warranted to explore whether recanalization and TIPS insertion should be used more frequently in acute PVT with the purpose to prevent chronic PVT.

This study was limited by its retrospective design, and by the fact that only patients with recognized portal vein occlusions who were referred to IR were studied. This may limit the generalizability of the results.

In conclusion, recanalization and insertion of a TIPS is safe and effective in patients with acute and chronic PMVT with or without cirrhosis. Recanalization was frequently possible in chronic PMVT even when there were no visible native branches of the SMV on CT. Recanalization was less challenging to perform and more likely to stay patent in acute compared with chronic PMVT.

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