

TIPS and PTO (PTS) (Akira Yamamoto, MD, PhD)

TIPS (transjugular intrahepatic portosystemic shunt) and PTO (percutaneous transhepatic obliteration)

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Introduction

As a treatment of portal hypertension, a transjugular intrahepatic portosystemic shunt (TIPS) has been performed for complications such as esophageal variceal bleeding and refractory ascites. Percutaneous transhepatic obliteration (PTO) has been performed for gastric varices (GV) and ectopic varices. In this session, current status of TIPS and PTO will be presented.

TIPS has been performed as portal decompression since 1989¹. TIPS creates an intrahepatic connection between the inflow portal vein and the outflow hepatic vein. The merit of TIPS is the action to reduce the portal venous pressure by functioning bypass of portal blood flow directly draining into systemic circulation, and create the access route to the portal venous system for repeating variceal embolization. As a result, TIPS is recommended especially for the patient wish ruptured esophageal varices and refractory ascites^{2,3}. However, a less common but serious disadvantages of TIPS is the risk of hepatic function worsening caused by diversion of portal venous blood flow. Patient selection is important issue for prevention of TIPS related liver dysfunction.

In the predated TIPS era, PTO has been used for the treatment of bleeding varices⁴. Although PTO could obtain initial hemostasis, recurrence rate of high⁵. In the classical PTO, coils, gelatin sponge, and cyanoacrylate have been used to embolize afferent gastric vein, but failed resulted in the regrowth of the residual varices with development of a collateral supply. To overcome this deficit, modified-PTO (m-PTO) or Percutaneous transhepatic sclerosis (PTS) has been developed to obtain sufficient variceal filling with sclerosing agents. Now, PTS is a good treatment option for the treatment of GV which has difficulty to treat by balloon-occluded retrograde transvenous obliteration (BRTO) and ectopic varices⁶.

TIPS

Indication of TIPS

The major indications of TIPS are secondary prophylaxis of variceal bleeding, refractory ascites, and refractory variceal bleeding. The clinical indications are hepatic hydrothorax, and Budd-Chiari syndrome and so on. Contraindications of TIPS are

primary prevention of variceal bleeding, congestive heart failure, severe tricuspid regurgitation, severe pulmonary hypertension (mean pulmonary pressure of > 45 mmHg) and so on. While many risk factors are identified with postprocedural death, patients with MELD score of >15 is reported to be in the high risk of postprocedural death^{7,8)}. Many physicians exclude patients with high MELD scores (≥ 18)⁹⁾. Recently in the Osaka City University Hospital, TIPS has been performed in only patients with MELD-Na score of $< =16$.

Pretherapeutic Imaging and Techniques

Pre-procedural imaging, especially contrast enhanced computed tomography should be reviewed to assess the portal vein patency, the location of the portal vein bifurcation, and the presence of gastroesophageal varices and other porto-systemic shunts. The procedure is performed on the monoplane or preferable biplane digital subtraction angiography equipment. After entry of the internal jugular vein, the TIPS set; usually Rosch-Uchida TIPS set made by Cook Medical (Bloomington, IN, United States) is introduced into the right hepatic vein. The needle puncture of the liver from a central portion of the hepatic vein to the distal portion of main right portal branch is performed with the cannula rotation approximately 90° anteriorly. During the portal vein puncture, the right hepatic arterial guidewire insertion is useful for guidance. The ultrasound-guidance during puncture and Carbon dioxide wedged hepatic venography before puncture might be also helpful to identify the portal vein. The needle tract is then dilated by a balloon catheter, and finally an expandable metallic stent or expanded polytetrafluoroethylene (ePTFE)-covered stent graft is inserted to maintain the tract patency. The size of the balloon catheter is usually 8 mm. The Additional balloon dilatation may be performed to finalize the shunt diameter. Anticoagulation is not routinely recommended, in general. But in our institution, heparin for the three days and cilostazol for the indefinite period are administered to prevent the obstruction of the TIPS tract with a bare stent.

Outcomes

The main outcomes for esophageal varices are reported in meta-analysis²⁾. Briefly, the meta-analysis showed that the decreased incidence of variceal rebleeding [odds ratio (OR)=0.32, 95% confidence interval (CI) (0.24-0.43), $P<0.00001$], deaths due to rebleeding [OR=0.35, 95% CI (0.18-0.67), $P=0.002$], the increased rate of posttreatment encephalopathy [OR=2.21, 95% CI (1.61-3.03), $P<0.00001$] were correlated with TIPS, whereas the hospitalization days [weighted mean difference=-0.21, 95% CI (-3.50 to 3.08), $P=0.90$] and deaths due to all causes [OR=1.17, 95% CI (0.85-1.61), $P=0.33$] returned negative results in 2 groups. In 2010, early TIPS was compared with pharmacotherapy and endoscopic variceal ligation (EVL) in Child-Pugh class C patients and class B patients with a high risk of treatment failure.

Sixty-two patients were randomized into the treatment group (early TIPS, n = 32), and control group (pharmacotherapy and EVL, n = 31). Rebleeding or failure to control bleeding occurred in one patient in the early TIPS group and 14 patients in the control group (P = 0.001). The one-year actuarial survival rate was 61% in the control group vs 86% in the early-TIPS group (P < 0.001)¹⁰.

The main outcomes for refractory ascites esophageal varices are also reported in meta-analysis³. In comparison to paracentesis, TIPS significantly improved LTF survival [HR = 0.61, 95%CI: 0.46-0.82, P < 0.001]. TIPS also significantly decreased liver disease-related death [OR = 0.62, 95%CI: 0.39-0.98, P = 0.04] recurrent ascites [OR = 0.15, 95%CI: 0.09-0.24, P < 0.001] and hepatorenal syndrome [OR = 0.32, 95%CI: 0.12-0.86, P = 0.02]. However, TIPS increased the risk of HE [OR = 2.95, 95%CI: 1.87-4.66, P = 0.02] and severe HE [OR = 2.18, 95%CI: 1.27-3.76, P = 0.005]. Complications after TIPS are summarized in Figure.

PTO

Indication of PTO

Alternative routes for transvenous obliteration can be classified into (A), portal venous access routes and (B), systemic venous access routes. The portal venous approach to transvenous obliteration is called balloon-occluded antegrade transvenous obliteration (BATO) and is a collective definition, including (1) PTO, (2) through an existing TIPS (Trans-TIPS), and (3) trans-iliocolic vein obliteration (TIO). PTO is usually from necessity; however, trans-TIPS approach is usually used because of the low-risk access route. TIO is rarely resorted to and almost always is utilized as an access for mesenteric varices/ectopic varices.

Transvenous obliteration of GV (with duodenal and mesenteric varices being similar) can be performed from the systemic venous side (draining veins/shunts) or from the portal venous side (portal afferent feeders). Balloon-occluded transvenous obliteration from the systemic veins is referred to as BRTO, and balloon-occluded transvenous obliteration from the portal veins is referred to as BATO¹¹. In general, BATO (including PTS) is considered an adjunct or an alternative to BRTO when BRTO fails completely or partially in obliterating the gastric varices. These technically challenging cases include failed gastroduodenal shunt catheterization, failed occlusion of gastroduodenal shunt due to large gastroduodenal shunt (larger than balloon-occlusion catheter), and duplicated gastroduodenal shunts/numerous venous collaterals with inability to occlude the gastric variceal system in its entirety.

Techniques of PTO

The techniques of percutaneous transhepatic puncture of the portal venous branch are similar to those of percutaneous transhepatic biliary drainage. Under ultrasonographic (US) guidance, a 18G needle is advanced into the right branch or

umbilical portion of portal vein. A 0.035-inch guide wire is advanced further to the main portal vein. Then, the outer plastic tube is exchanged to the 5F angiographic sheath. After superior mesenteric or splenic venous portography and selective angiography of the target branches are performed for evaluate the anatomical and hemodynamic feature of the lesions, a 5F occlusion balloon or micro balloon catheter is often used to control the blood flow during embolization procedure, which allows the stagnation of the embolic/ sclerosing agents in the target vessels and/or varices. Various sclerosing agents and embolic materials including EO, polidocanol, glue (cyanoacrylate-lipiodol mixture), gelatin sponge and coils has been used. Any embolic materials are generally effective for occlusion of the shunt; however, successful and stable obliteration of varices requires sclerosing agents or glue filling entirely the varices. For this purpose, liquid sclerosing/embolic agents should be injected in the varices or close to the varices under flow control by occlusion balloon and/or after coils embolization of the afferent and drainage vein. When the varices are supplied from multiple afferent veins, some of which should be occluded with coils before the injection of the sclerosing/embolic agent into the varices. After embolization procedure, portography is performed to evaluate the obliteration of the varices or shunt and portal venous hemodynamics including portal venous flow and collaterals. Then, the catheter and sheath are withdrawn with embolizing the puncture tract in the hepatic parenchyma with coils, gelform and/or glue.

Outcomes

A large study is no reported regarding BATO/PTS. Percutaneous transhepatic obliteration by itself was successful in 44-100% of cases. Recurrence rate was considered to be higher when compared with BRTO.

Endovascular management for ectopic varices

Although uncommon, ectopic varices can involve any other part of gastrointestinal tract and challenging for IRists to manage. The term ectopic varices has been used to describe variceal veins other than those found in the esophagus and stomach. Ectopic varices are sometimes observed in the duodenum, small intestine, colon, rectum, peristomal, peritoneum, umbilicus.

Duodenal varices: The afferent vessel originates either from the SMV or from the portal vein trunk via either superior or inferior pancreaticoduodenal vein. The efferent vein drains into IVC via gonadal vein. These can be treated by BATO including PTS, BRTO, dual balloon-occluded embolotherapy (DBOE) according to the vasculature.

Rectal varices: Prevalence of rectal varices patients with portal hypertension varies from 28%-56% in cirrhotic patients These result from communication between the superior rectal vein (draining into portal vein via IMV) and the middle or inferior rectal vein that drains into IVC via internal iliac veins. These can be mostly treated by

BATO including PTS according to the vasculature. BRTO is effective in selected case such as their draining vein is simple and accessible.

Conclusion

TIPS is an effective and safety treatment for the selected patents with complications related to portal hypertension such as esophageal varices and refractory ascites.

BATO including PTS is also reliable for obliteration of some of portosystemic shunt and the varices especially for the cases difficult to treat by BRTO.

References

- 1) Righter G. The transjugular intrahepatic portosystemic stent-shunt. A new nonsurgical percutaneous method *Radiologie* 1989; 29:406-11.
- 2) Zheng M, Chen Y, Bai J, et al. Transjugular intrahepatic portosystemic shunt versus endoscopic therapy in the secondary prophylaxis of variceal rebleeding in cirrhotic patients: meta-analysis update. *J Clin Gastroenterol* 2008; 42:507-16.
- 3) Bai M, Qi XS, Yang ZP, Yang M, Fan DM, Han GH. TIPS improves liver transplantation-free survival in cirrhotic patients with refractory ascites: an updated meta-analysis. *World J Gastroenterol* 2014; 20:2704-14.
- 4) Lunderquist A, Vang J. Transhepatic catheterization and obliteration of the coronary vein in patients with portal hypertension and esophageal varices. *N Engl J Med* 1974; 291:646-9.
- 5) Smith-Laing G, Scott J, Long RG, Dick R, Sherlock S. Role of percutaneous transhepatic obliteration of varices in the management of hemorrhage from gastroesophageal varices. *Gastroenterology* 1981; 80:1031-6.
- 6) Macedo TA, Andrews JC, Kamath PS. Ectopic varices in the gastrointestinal tract: short- and long-term outcomes of percutaneous therapy. *Cardiovasc Intervent Radiol* 2005; 28:178-84.
- 7) Guy J, Somsouk M, Shiboski S, Kerlan R, Inadomi JM, Biggins SW. New model for end stage liver disease improves prognostic capability after transjugular intrahepatic portosystemic shunt. *Clin Gastroenterol Hepatol* 2009; 7:1236-40.
- 8) Pan JJ, Chen C, Caridi JG, et al. Factors predicting survival after transjugular intrahepatic portosystemic shunt creation: 15 years' experience from a single tertiary medical center. *J Vasc Interv Radiol* 2008; 19:1576-81.
- 9) Spengler EK, Hunsicker LG, Zarei S, Zimmerman MB, Voigt MD. Transjugular intrahepatic portosystemic shunt does not independently increase risk of death in high model for end stage liver disease patients. *Hepatol Commun* 2017; 1:460-8.
- 10) Garcia-Pagan JC, Caca K, Bureau C, et al. Early use of TIPS in patients with cirrhosis and variceal bleeding. *N Engl J Med* 2010; 362:2370-9.
- 11) Saad WE, Sze DY. Variations of Balloon-occluded Retrograde Transvenous

31. TIPS and PTO (PTS) (Akira Yamamoto, MD, PhD)

Obliteration (BRTO): Balloon-occluded Antegrade Transvenous Obliteration (BATO) and Alternative/Adjunctive Routes for BRTO. *Semin Intervent Radiol* 2011; 28:314-24.