Review Article

Transjugular intrahepatic portosystemic shunts versus balloon-occluded retrograde transvenous obliteration for the management of gastric varices: Treatment algorithm according to clinical manifestations

Seung Kwon Kim,* Steven Sauk, Carlos J. Guevara

A B S T R A C T

Transjugular intrahepatic portosystemic shunts (TIPS) are widely used in the management of bleeding gastric varices (GV). More recently, several studies have demonstrated balloon-occluded retrograde transvenous obliteration (BRTO) as an effective treatment method for bleeding isolated GV, especially in patients with contraindications for a TIPS placement. Both TIPS and BRTO can effectively treat bleeding GV with low rebleeding rates. Careful patient selection for TIPS and BRTO procedures is required to best treat the patient’s individual clinical situation.

Introduction

Variceal bleeding is a serious complication of portal hypertension. Esophageal varices (EV) are routinely treated via endoscopic methods; however, the long term success of endoscopically treated gastric varices (GV) are limited in part due to high flow through the varix and also the location of the varices in the cardia/gastric fundus. In addition, due to its size, sclerosis of GV often requires a larger volume of sclerosant and creates a higher risk of non-target embolization predominately to the pulmonary system. Transjugular intrahepatic portosystemic shunts (TIPS) are also widely used in the management of GV; however, high-level evidence of its decompressive benefits for isolated GV are lacking and shunting portal blood flow can further compromise liver function and aggravate hepatic encephalopathy.

Several studies have demonstrated that balloon-occluded retrograde transvenous obliteration (BRTO) is effective in the treatment of bleeding isolated GV, which are often associated with spontaneous gastrorenal shunts. Furthermore, this procedure is an effective way to treat GV in patients with contraindications for TIPS placement. Absolute contradictions for TIPS placement are right heart failure, severe pulmonary hypertension, severe tricuspid regurgitation, uncontrolled systemic infection or sepsis, unrelieved biliary obstruction, and liver failure. Relative contraindication for TIPS placement are central hepatocellular carcinoma, obstruction of all hepatic veins, portal vein thrombosis, severe coagulopathy, hepatic encephalopathy and high MELD (model for end-stage liver disease) score.

Herein, we review the clinical outcomes of TIPS and BRTO procedures and propose a GV treatment algorithm to best treat the patient’s individual clinical situation.

Clinical Outcomes of the TIPS Procedure for GV

Table 1 summarizes the clinical outcomes of TIPS procedures for the management of GV. There are limited data addressing TIPS for the treatment of GV, as most TIPS studies have included all EV with or without GV. There are eight studies evaluating the placement of a TIPS for bleeding GV. These eight studies evaluated a total of 201 patients (range for individual studies, 7–35 patients). Four of these studies have intra-institutional comparisons with BRTO outcomes. The first six studies report using...
bare stents for the creation of TIPS12–17 and more recent studies report using covered stents.16,19 Two studies were published before the year 2000 and had a total of 60 patients with actively bleeding GV that underwent TIPS with bare metal stents.12,13 The 6- to 7-month and 12-month rebleeding rates were 26% to 29% and 31%, respectively. Another four studies were published between 2000 and 2007, which evaluated a total of 87 patients with GV that underwent a TIPS procedure with bare metal stents.14–17 The post-TIPS rebleeding rates were between 11% and 20%, after a median follow-up of 33 to 75 weeks. It is important to note that the TIPS created with bare metal stents are known to have lower patency rates when compared to covered stents, and likely account for their higher rebleeding rates. The two most recent studies evaluated the outcome for the treatment of GV by creating a TIPS using covered stents.14,19 These studies showed lower rebleeding rates (7%–11%) compared with previous TIPS created with covered stents.18–20 The wide range of reported rates is thought to be related to the variation in patient population, causes and severities of liver disease, as well as the durations of follow-up.

### Clinical Outcomes of BRTO Procedures for GV

Table 2 summarizes the clinical outcomes of BRTO procedures for the management of GV. Overall, the technical success rates of BRTO for patients with gastrorenal/splenorenal shunts and GV range from 89% to 100%.18,21–25 Procedure complications include gross hematuria with hemoglobinuria-induced renal failure (up to 4.8%), pulmonary embolism (1.5%–4.1%), anaphylaxis to ethanolamine olate (up to 5%), cardiac arrhythmias (up to 1.5%), and rapidly declining hepatic function (5%–7%). The 30-day mortality rates range from zero to 4.1%, and the most common cause of death is progressive liver failure.8,11,16,20–25 Most of these complications were related with use of ethanolamine olate. However, ethanolamine olate is no longer available in many countries including Korea since several years ago. After that, sodium tetradesyl sulfate (STS) foam is widely used for BRTO procedure,8,19 and complication of BRTO has also changed. For example, STS foam does not make renal failure. But it could make air embolism. So, total amount of STS foam is limited to avoid air embolism. Another potential complication of BRTO using STS foam might be cerebral stroke related to portopulmonary venous anastomosis.26

Other complications from increased portal hypertension after BRTO are the development of portal hypertensive gastropathy (5%–13%) and possibly ascites (0%–44%) and hydrothorax/pleural effusion (0%–8%).8,11,16,20–25

One of the most important reported complications associated with BRTO is the aggravation of EV. Reported rates of worsening EV vary up to 63%, with 11% to 24% subsequent variceal bleeding rate.8,11,16,20–25 The wide range of reported rates is thought to be related to the variation in patient population, causes and severities of liver disease, as well as the duration of follow-up. New techniques of BRTO using vascular plug or coils have introduced although it would be premature to be the confirmative techniques for the treatment of gastric varix yet.27–29 Because sclerosing agent and techniques have been changed, complication would be also different from complications from previous BRTO procedures.

### Table 1 Clinical Outcomes of TIPS Procedure for the Management of Gastric Varices

| Author (year)   | Number of patients | Type of TIPS stent | Rebleeding rate (%) | Hepatic encephalopathy (%) |
|-----------------|--------------------|--------------------|---------------------|---------------------------|
| Chau et al (1998)   | 28                | Bare stent         | 29                  | 3                          |
| Barange et al (1999) | 32              | Bare stent         | 31                  | 16                         |
| Rees et al (2000)   | 12                | Bare stent         | 16                  | NA                        |
| Choi et al (2003)   | 13                | Bare stent         | 14                  | 43                         |
| Ninoi et al (2004)  | 27                | Bare stent         | 20                  | 19                         |
| Lo et al (2007)     | 35                | Bare stent         | 11                  | 26                         |
| Sabri et al (2014)  | 27                | Covered stent      | 11                  | 15                         |
| Sauk et al (2014)   | 27                | Covered stent      | 7                   | 22                         |

TIPS, transjugular intrahepatic postosystemic shunts; NA, not available.

### Table 2 Clinical Outcomes of BRTO Procedure for the Management of Gastric Varices

| Author (year)   | Number of patients | Technical success (%) | Rebleeding rate (%) | Complete obliteration (%) |
|-----------------|--------------------|-----------------------|---------------------|----------------------------|
| Kanagawa et al (1996) | 32             | 100                   | 0                   | 97                         |
| Sonomura et al (1998) | 14            | 100                   | 0                   | 86                         |
| Kitamoto et al (2002) | 24            | 96                    | 9                   | 88                         |
| Ninoi et al (2004)   | 78                | 87                    | 0                   | 95                         |
| Arai et al (2005)    | 11                | 100                   | 9                   | 91                         |
| Cho et al (2007)     | 49                | 84                    | 0                   | 100                        |
| Hiraga et al (2007)  | 34                | 97                    | 3                   | 91                         |
| Sabri et al (2014)   | 23                | 91                    | 0                   | 88                         |
| Sauk et al (2014)    | 25                | 100                   | 12                  | 87                         |

BRTO, balloon-occluded retrograde transvenous obliteration.
Gastric variceal bleeding  $\rightarrow$ TIPS or BRTO

+ Esophageal varix

TIPS

Banding of esophageal varix + BRTO

+ Intractable ascites or hydrothorax

If MELD score $< 20$

TIPS or BRTO

If MELD score $\geq 20$

BRTO

+ PV thrombosis and GR shunt

+ Central HCC

BRTO

+ Severe encephalopathy

Fig. 1. Gastric varices treatment algorithm according to clinical manifestations. TIPS, transjugular intrahepatic portosystemic shunts; BRTO, balloon-occluded retrograde transvenous obliteration; MELD, model for end-stage liver disease; PV, portal vein; GR shunt, gastrorenal shunt; HCC, hepatocellular carcinoma.

Fig. 2. A 64-year-old male with alcoholic cirrhosis, portal vein thrombosis and cavernous malformation of the gastric variceal bleeding. (A) Initial venogram following access through the right internal jugular vein and catheterization of the gastrorenal shunt shows filling of the collateral left inferior phrenic vein (dashed arrows) along with the gastric varices (GV) (arrow). (B) Left inferior phrenic vein is embolized using a microcatheter and micro-Nester coils. (C) Spot image post embolization of the GV shows inflated balloon catheter along with pooling of the dense embolization material within the GV (arrowhead). (D) Follow-up upper gastrointestinal endoscopy 6 months after the procedure shows grade II lower esophageal varices (EV) (arrows), without evidence of bleeding. These EV are successfully banded. (E) Follow-up computed tomography scan of the abdomen 12 months post procedure shows persistent portal vein thrombosis (arrow) with cavernous malformation of the portal vein (dashed arrow). (F) Note persistent dense embolization material within the previous GV (arrow). Patient remains symptoms free on the follow-up for more than 3 years.
In most studies, gastric variceal rebleeding rates of patients who had undergone a successful BRTO procedure range from zero to 12% after a median follow-up of 33 to 75 weeks, and rates for complete obliteration of GV range from 86% to 97%.8,11,16,18,19,20–25

**Comparative Studies of TIPS and BRTO Procedures for GV**

Limited intra-institutional studies have compared the outcomes of TIPS and BRTO in management of GV.15,16,18,19 In a study by Choi et al.,15 21 patients with active gastric variceal bleeding due to cirrhosis were treated with either TIPS (n = 13) or BRTO (n = 8), and no statistically significant difference in hemostasis and rebleeding was noted after a mean follow-up of 14 months. A larger study by Ninoi et al.16 evaluated 104 patients, 27 of which were treated with TIPS, and 77 patients with transcatheter sclerotherapy, treated through a retrograde or antegrade approach. Cumulative gastric variceal bleeding rate at one year was significantly better in the BRTO group (TIPS = 20% vs BRTO = 2%, P < 0.01). Furthermore, survival rates at 1, 3, and 5 years after a BRTO was performed were significantly better than that after a TIPS. However, the improved survival was only statistically significant for patients preoperatively categorized as Child-Pugh class A, but not Child-Pugh class B or C.16 Bare stents were used in these two studies, which, as discussed before, are known to have lower patency when compared to covered stents, and likely account for the higher rebleeding rates. More recently, Sabri et al.18 demonstrated equivalent short term rebleeding rates for isolated GV managed by TIPS with covered stents (11%) and BRTO (0%) in 50 patients (P = 0.25). Another recent study by Sauk et al.19 demonstrated no significant difference in rebleeding rates from isolated GV managed by TIPS with covered stents (7%) and by BRTO (12%) in 52 patients (P = 0.46). In this study, two of 27 patients who received TIPS presented with rebleeding from an oozing gastric varix, one of whom required a TIPS revision. Among the BRTO group, two of 25 patients presented with repeat gastric variceal bleeding within two days following the procedure, which were subsequently treated with a TIPS placement.

**GV Treatment Algorithms according to Clinical Manifestations**

We propose an algorithmic and staged approach for the treatment of GV according to the patients’ clinical situation (Fig. 1).

As discussed from the review of the literature, for the treatment of isolated GV, both TIPS and BRTO can effectively treat GV.
with low rebleeding rates. If there is EV in addition to GV, a TIPS procedure or BRTO after endoscopic ligation of the EV can be performed.

For patients with GV and intractable ascites or hydrothorax, TIPS is a better option because it will also decompress the portal system and treat the ascites or hydrothorax. However, if a patient’s MELD score is high, a BRTO procedure would be a better option because it will preserve hepatic function as opposed to the TIPS, while exacerbating the ascites or hydrothorax. A recent retrospective study, by Saad and colleagues,30,31 concluded that the presence of a patent TIPS prior to BRTO or the creation of TIPS at the time of BRTO prevented patients from developing post-BRTO ascites/hydrothorax as well as recurrent bleeding.

In patients with cavernous transformation of a chronically thrombosed main portal vein, a TIPS procedure could be technically difficult. If there is a gastrorenal shunt on cross sectional images, BRTO could be performed in patients with bleeding GV (Fig. 2).

If there is a centrally located tumor and no window for the TIPS stent to land without violating the tumor, a BRTO would be a better option than TIPS (Fig. 3), so as to avoid tumor embolization.

For patients with GV and severe hepatic encephalopathy, BRTO would be a better option. One of the emerging indications for BRTO is hepatic encephalopathy with the presence of a gastrorenal or splenorenal shunt.8,27,28,32–38 BRTO can preserve hepatic function and improve the hepatic encephalopathy. In five studies evaluating a total of 35 patients with encephalopathy there was resolution or significant reduction in encephalopathy in all patients.8,32,33,34,38

BRTO is a good alternative in patients in whom a TIPS placement is technically difficult, or if there is recurrent gastric variceal bleeding even after TIPS revision. According to Chao et al’s study,39 mean hepatic venous pressure gradient was 11.2 mmHg for GV and 15.5 mmHg for EV. So, there is a higher likelihood of having a diminished portal pressure (< 12 mmHg) in patients with GV. Thus, TIPS creation in these patients to further reduce the portosystemic gradient may not have a dramatically beneficial hemodynamic effect on the gastric variceal system, and can result in higher rebleeding rates than in patients with bleeding EV.39,40 Therefore, adding BRTO to TIPS can be effective in controlling gastric variceal bleeding (Fig. 4).

On the other hand, if the BRTO procedure is complicated by vein rupture or balloon rupture with subsequent clinical failure, TIPS could be placed (Fig. 5).

**Conclusion**

Both TIPS and BRTO can effectively treat bleeding GV with low rebleeding rates. Careful patient selection for TIPS and BRTO procedures is required to best treat the patient’s individual clinical situation.

**Conflicts of Interest**

No potential conflict of interest relevant to this article was reported.

**Acknowledgments**

This paper was presented as a scientific paper at the 2014 Annual Meeting of Society of Interventional Radiology in San Diego,
Fig. 5. A 63-year-old woman with underlying cirrhosis presenting with acute gastric variceal bleeding. (A) Coronal magnetic resonance (MR) image shows large gastric varices (GV) with gastrorenal shunt (arrow). (B) After balloon inflation, GV (arrow) are then embolized using sodium tetradecyl sulfate (Sotradecol; AngioDynamics, Queensbury, NY, USA) mixed with Lipiodol (Ethiodol; Savage Laboratories, Melville, NY, USA). The occlusion balloon is found to be ruptured and the patient has continuous gastric variceal bleeding. Two days after balloon-occluded retrograde transvenous obliteration, she underwent transjugular intrahepatic portosystemic shunts (TIPS) procedure. (C) Initial portal venogram shows retrograde filling of the GV from the left gastric vein (arrow). (D) TIPS stent is successfully placed and left gastric vein is embolized with multiple coils (arrow). (E) Four months after TIPS procedure, she underwent TIPS reduction procedure due to hepatic encephalopathy with resulting central narrowing (arrow). (F) Twenty-seven months follow-up coronal MR image shows complete obliteration of GV.

References

1. Sarin SK, Lahoti D, Saxena SP, Murthy NS, Malwana UK. Prevalence, classification and natural history of gastric varices: a long-term follow-up study in 568 portal hypertension patients. Hepatology. 1992;16:1343-9.
2. Ryan BM, Stockbrugger RW, Ryan JM. A pathophysiologic, gastroenterologic, and radiologic approach to the management of gastric varices. Gastroenterology. 2004;126:1175-89.
3. Al-Osaimi AM, Caldwell SH. Medical and endoscopic management of gastric varices. Semin Intervent Radiol. 2011;28:273-82.
4. Lo GH, Lai KH, Cheng JS, Chen MH, Chiang HT. A prospective, randomized trial of butyl cyanoacrylate injection versus band ligation in the management of bleeding gastric varices. Hepatology. 2001;33:1060-4.
5. Kerlan RK Jr, LaBerge JM, Baker EL, Wack JP, Marx M, Somberg KA, et al. Successful reversal of hepatic encephalopathy with intentional occlusion of transjugular intrahepatic portosystemic shunts. J Vasc Interv Radiol. 1995;6:917-21.
6. Brown RS Jr, Lake JR. Transjugular intrahepatic portosystemic shunt as a form of treatment for portal hypertension: indications and contraindications. Adv Intern Med. 1997;42:485-504.
7. Sanyal AJ, Freedman AM, Luketic VA, Purdum PP 3rd, Shiffman ML, DeMeo J, et al. The natural history of portal hypertension after transjugular intrahepatic portosystemic shunts. Gastroenterology. 1997;112:889-98.
8. Fukuda T, Hirota S, Sugimura K. Long-term results of balloon-occluded retrograde transvenous obliteration for the treatment of gastric varices and hepatic encephalopathy. J Vasc Interv Radiol. 2001;12:327-36.
9. Kiyosue H, Mori H, Matsumoto S, Yamada Y, Hori Y, Okino Y. Transcatheter obliteration of gastric varices. Part 1. Anatomic classification. Radiographics. 2003;23:911-20.
10. Kiyosue H, Mori H, Matsumoto S, Yamada Y, Hori Y, Okino Y. Transcatheter obliteration of gastric varices: Part 2. Strategy and techniques based on hemodynamic features. Radiographics. 2003;23:921-37; discussion 937.
11. Ninoi T, Nishida N, Kaminou T, Sakai Y, Kitayama T, Hamuro M, et al. Balloon-occluded retrograde transvenous obliteration of gastric varices with gastrorenal shunt: long-term follow-up in 78 patients. AJR Am J Roentgenol. 2005;184:1340-6.
12. Chau TN, Patch D, Chan YW, Nagral A, Dick R, Burrows RH, “Salvage” transjugular intrahepatic portosystemic shunts: gastric fundal varices compared with esophageal varical bleeding. Gastroenterology. 1998;114:981-7.
13. Barange K, Péron JM, Imani K, Otal P, Payen JL, Rousseau H, et al. Transjugular intrahepatic portosystemic shunt in the treatment of refractory bleeding from ruptured gastric varices. Hepatology. 1999;30:1139-43.
14. Rees CJ, Nylander DL, Thompson NP, Rose JD, Record CO, Hudson M. Do gastric and oesophageal varices bleed at different portal pressures and is TIPS an effective treatment? Liver. 2000;20:257-6.
15. Choi YH, Yoon CJ, Park JH, Chung JW, Kwon JW, Choi GM. Balloon-occluded retrograde transvenous obliteration for gastric variceal bleeding: its feasibility compared with transjugular intrahepatic portosystemic shunt. Korean J Radiol. 2003;4:109-16.
16. Ninoi T, Nakamura K, Kaminou T, Nishida N, Sakai Y, Kitayama T, et al. TIPS versus transcatheter sclerotherapy for gastric varices. AJR Am J Roentgenol. 2004;183:369-76.
17. Lo GH, Liang HL, Chen WC, Chen MH, Lai KH, Hsu PL, et al. A prospective, randomized controlled trial of transjugular intrahepatic portosystemic shunt versus
cyanoacrylate injection in the prevention of gastric variceal rebleeding. *Endoscopy*. 2007;39:679-85.
18. Sahri SS, Al-Jawaideh N, Swei W, Saad WE, Turha UC, Caldwell SH, et al. Short-term rebleeding rates for isolated gastric varices managed by transjugular intrahepatic portosystemic shunt versus balloon-occluded retrograde transvenous obliteration. *J Vasc Interv Radiol*. 2014;25:355-61.
19. Sauck S, Niemeyer M, Kim SK, Korenblat K. Outcomes from balloon-occluded retrograde transvenous obliteration (BRTO) versus transjugular intrahepatic portosystemic shunt (TIPS) in the management of isolated gastric varices: a retrospective study in single US medical center. *J Vasc Interv Radiol*. 2014;25(Suppl 3):S80.
20. Kanagawa H, Miwa S, Kouyama H, Gotoh K, Uchida T, Okada K. Treatment of gastric fundal varices by balloon-occluded retrograde transvenous obliteration. *J Gastroenterol Hepatol*. 1996;11:51-8.
21. Sonomura T, Sato M, Kishi K, Terada M, Shioyama Y, Kimura M, et al. Balloon-occluded retrograde transvenous obliteration for gastric varices: a feasibility study. *Cardiovasc Intervent Radiol*. 1998;21:27-30.
22. Kitanaka M, Imamura M, Kamada K, Aikata H, Kawakami Y, Matsumoto A, et al. Balloon-occluded retrograde transvenous obliteration of gastric fundal varices with hemorrhage. *AJR Am J Roentgenol*. 2002;178:1167-74.
23. Arai H, Abe T, Shimoda R, Takagi H, Yamada T, Mouri M, Emergency balloon-occluded retrograde transvenous obliteration for gastric varices. *J Gastroenterol*. 2005;40:964-71.
24. Cho SK, Shin SW, Lee IH, Do YS, Choo SW, Park KB, et al. Balloon-occluded retrograde transvenous obliteration of gastric varices: outcomes and complications in 49 patients. *AJR Am J Roentgenol*. 2007;189:W365-72.
25. Hiraga N, Aikata H, Takaki S, Kodama H, Shirakawa H, Imamura M, et al. The long-term outcome of 8 patients with bleeding gastric varices after balloon-occluded retrograde transvenous obliteration. *J Gastroenterol*. 2007;42:663-72.
26. Kariya S, Komemushi A, Nakatani M, Yoshida R, Kono Y, Shiraishi T, et al. Protective value of TIPS against the development of hydrothorax/asites and upper gastrointestinal bleeding after balloon-occluded retrograde transvenous obliteration (BRTO). *Am J Gastroenterol*. 2013;108:1612-9.
27. Saad WE. Combining transjugular intrahepatic portosystemic shunt with balloon-occluded retrograde transvenous obliteration or augmenting TIPS with variceal embolization for the management of gastric varices: an evolving middle ground? *Semin Intervent Radiol*. 2014;31:266-8.
28. Hirota S, Matsumoto S, Tomita M, Sako M, Kono M. Retrograde transvenous obliteration of gastric varices. *Radiology*. 1999;211:349-56.
29. Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Eight years of experience with transjugular retrograde obliteration for gastric varices with gastrorenal shunts. *Surgery*. 2001;129:414-20.
30. Park KS, Kim YH, Choi JS, Hwang JS, Kwon JH, Jang BK, et al. Therapeutic efficacy of balloon-occluded retrograde transvenous obliteration in patients with gastric variceal bleeding. *Korean J Gastroenterol*. 2006;47:370-8.
31. Yamagami T, Kato T, Hirota H, Yoshimatsu R, Matsumoto T, Nishimura T, Infusion of 50% glucose solution before injection of ethanolamine oleate during balloon-occluded retrograde transvenous obliteration. *Aust Radiol*. 2007;51:334-8.
32. Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Combination treatment of transjugular retrograde obliteration and endoscopic embolization for portal systemic encephalopathy with esophageal varices. *Hepatogastroenterology*. 2004;51:1379-81.
33. Takuma Y, Nousou K, Makino Y, Saito S, Shiratori Y. Prophylactic balloon-occluded retrograde transvenous obliteration for gastric varices in compensated cirrhosis. *Clin Gastroenterol Hepatol*. 2005;3:1245-52.
34. Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Transjugular retrograde obliteration for chronic portosystemic encephalopathy. *Abdom Imaging*. 2000;25:567-71.
35. Chao Y, Lin HC, Lee FY, Wang SS, Tsai YT, Hsia HC, et al. Hepatic hemodynamic features in patients with esophageal or gastric varices. *J Hepatol*. 1993;19:85-9.
36. Saad WE, Darcy MD. Transjugular intrahepatic portosystemic shunt (TIPS) versus balloon-occluded retrograde transvenous obliteration (BRTO) for the management of gastric varices. *Semin Intervent Radiol*. 2011;28:339-49.