

Balloon-Occluded Retrograde Transvenous Obliteration of Gastric Varices

A review of the anatomy, technique, and outcomes.

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Gastric fundal varices with hemorrhage are associated with a higher mortality rate than esophageal variceal bleeding,¹⁻³ and therefore, optimal management of gastric varices requires a multidisciplinary approach. Generally, various treatment modalities such as pharmacotherapy, balloon tamponade, endoscopic procedures, endovascular treatment, and surgery have been performed. Transjugular intrahepatic portosystemic shunt (TIPS) has been widely used to treat bleeding esophageal and gastric varices.⁴⁻⁹

Although studies have demonstrated successful initial control of bleeding in both esophageal and gastric varices, rebleeding rates post-TIPS have been higher with gastric varices. In fact, gastric varices can still bleed despite portal pressure gradients below 12 mm Hg, and TIPS is not always effective in such patients with low initial portal pressure gradients.^{6,9,10} In addition, TIPS may not be tolerated in patients with encephalopathy or poor liver function.

Balloon-occluded retrograde transvenous obliteration (BRTO) is an endovascular technique that was developed in Japan^{11,12} as a therapeutic adjunct or alternative to TIPS in the management of gastric varices. It is also an effective therapy for sclerosis of de novo portosystemic shunts complicated by hepatic encephalopathy. A BRTO procedure involves occlusion of outflow veins of the portosystemic shunt, such as a gastorenal shunt, using an occlusion balloon followed by the injection of a sclerosing agent directly into the varix endovascularly.¹³

Stagnation of the sclerosant within the varix or shunt without reflux into either the portal or systemic vasculature is critical to the procedure because this can result in serious complications. To avoid these events, occlusion balloons are strategically placed to modulate the flow within the varix and/or shunt. Additionally, microcatheters and embolization coils are adjunctive tools that are used to administer the sclerosant in high concentration within the varix and prevent reflux to non-target sites.

The complexity of gastric varices cannot be overstated. This article reviews the relevant anatomy and the integral relationship between the anatomy and the therapeutic approach, describes the technical aspects of the procedures, and reports outcomes.

ANATOMIC CLASSIFICATION SYSTEM FOR VARICES

Successful BRTO therapy relies on an integral knowledge of gastric variceal anatomy. In the majority of cases, the anatomy of the varix dictates the approach used for treatment. An understanding of the afferent and efferent veins is of paramount importance, because the degree of difficulty in performing BRTO is directly correlated with the anatomic complexity of the varix. In 2003, Kiyosue et al outlined an anatomic classification of gastric varices that reflects these features.^{14,15} The gastric varices are supplied by a single or multiple afferent gastric veins, commonly the left gas-

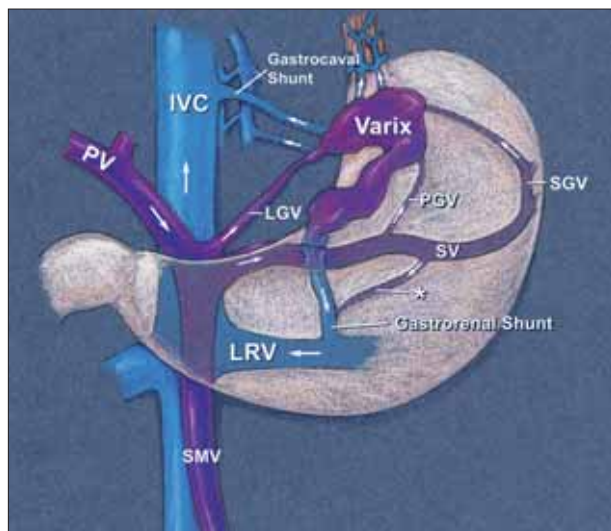


Figure 1. Most common variceal anatomic variants.

Abbreviations: IVC, inferior vena cava; LGV, left gastric vein; LRV, left renal vein; PGV, posterior gastric vein; PV, portal vein; SGV, short gastric vein; SMV, superior mesenteric vein; SV, splenic vein. *Direct communication between gastric vein and gastrorenal or gastrocaval shunt.

tric, but it has also been seen with the posterior or short gastric veins, and rarely, the gastroepiploic vein (Figure 1). Varices are more importantly categorized based on their draining venous pattern (Figure 2). Type A varices are contiguous with a single draining shunt, commonly a gastrorenal shunt. Type B varices are contiguous with a single shunt and one or multiple

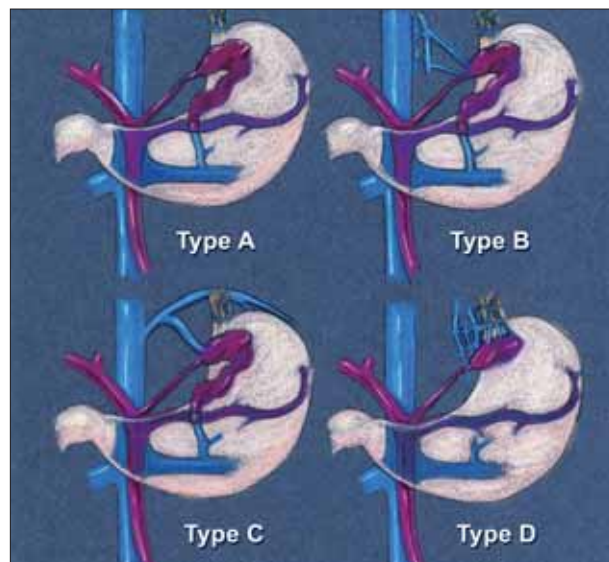


Figure 2. Classification based on venous drainage. Type A has a shunt with a single draining vein. Type B has a shunt with multiple collateral draining veins. Type C has both a gastrocaval and gastrorenal shunt. Type D has multiple small draining veins and no shunt.

collateral veins. Three additional subtypes of type B varices reflect the flow and size of these collaterals. Type C varices are contiguous with both a gastrorenal and gastrocaval shunt. Two additional subtypes of type C varices reflect the relative sizes of these two shunts. Type D varices, which will not be discussed in this article, drain via small collaterals and are not

TABLE 1. VARICEAL ANATOMY AND APPROACH

Varix Type	Relevant Anatomy	Treatment Steps
A	Defined by the presence of a single draining vein	<ol style="list-style-type: none"> 1. Access of the right femoral vein using standard angiographic technique. 2. Catheterization of the gastrorenal shunt via the left renal vein is typically accomplished using a catheter with a mounted occlusion balloon. 3. Balloon occlusion venography performed to confirm type of varix. 4. Infusion of sclerosant until adequate to fill the full extent of the varix with minimal filling of the afferent vein/portal vasculature.
B	Defined by the presence of collateral draining veins	Standard BRTO technique as described for type A. Selective use of a microcatheter or advancement of the balloon catheter further into the draining vein can be performed to optimize sclerosant delivery. When high-flow collateral veins are present, these must first be occluded with microcoils delivered sequentially to each collateral vein.
C	Defined by the presence of both a gastrocaval and gastrorenal shunt of asymmetric sizes/flow	Standard BRTO technique as described for type A. Embolize the smaller shunt with coils, then standard BRTO is performed. For larger shunts, occlusion balloons are manipulated into the outflow of both the gastrocaval and gastrorenal shunts.

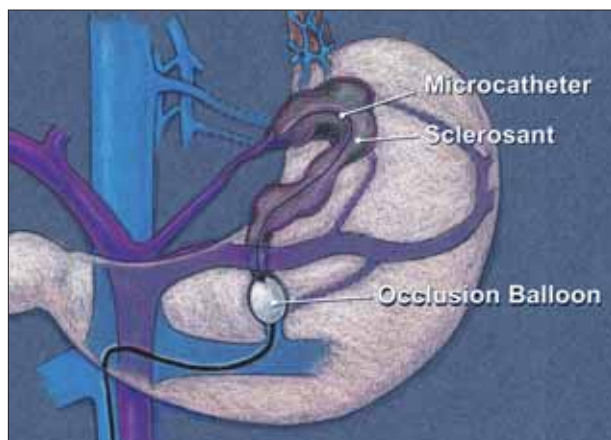


Figure 3. Standard BRTO treatment. An occlusion balloon is advanced through the left renal vein into the gastroduodenal shunt and inflated. Through it, a microcatheter is advanced into the varix. Sclerosant is injected under fluoroscopic guidance until the varix and draining shunt are adequately filled with caution to avoid reflux into the afferent vein and portal vasculature.

directly contiguous with either the inferior vena cava or renal vein.

TECHNIQUE

BRTO has become the treatment of choice for gastric varices in many hospitals in Asia and is becoming a favorable option in the United States as well. The complexity of the variceal anatomy mandates a customized approach and is outlined in Table 1, which discusses the relevant anatomy and treatment steps.

The procedural main steps are (Figures 3 and 4):

1. Access of the right femoral or internal jugular vein using standard angiographic technique and placement of a 6- to 12-F sheath. Most of the reported cases in the literature have been described using the right femoral vein approach. Certain institutions have adopted the jugular vein approach exclusively. The authors suggest reviewing the preprocedure computed tomographic angiogram (CTA) or magnetic resonance image to decide the approach that provides the best angle for selecting the shunt.

2. Catheterization of the gastroduodenal shunt via the left renal vein is typically accomplished using a catheter with a mounted occlusion balloon. Reverse-shaped balloon catheters are available in Asia and provide easier and stable access into the shunt; however, such catheters are not readily available in the United States. Access into the shunt can be achieved by selective catheterization of the left renal vein using a forward-seeking catheter such as a Cobra-shaped catheter, which is then exchanged for an

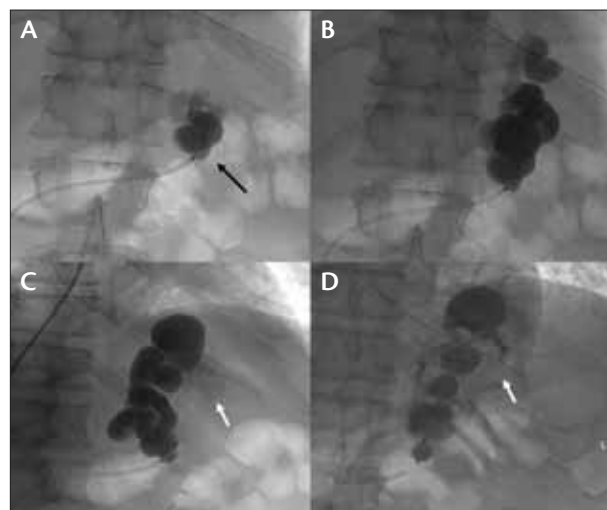


Figure 4. Occlusion balloon (black arrow) is occluding the shunt (A). Venography is performed through the occlusion balloon and shows a type A varix (B and C). STS foam with lipiodol is seen filling the varix with filling of the afferent vein (white arrow) (D).

angled-tip catheter and can be used to select the shunt. A 0.035-inch stiff wire is then advanced into the shunt, followed by a standard occlusion balloon catheter (8.5–32 mm). The access sheath is usually positioned in the inferior vena cava or renal vein.

3. Balloon occlusion venography is performed to define the anatomy and type of varix.

4. Infusion of a sclerosant follows. The goal is filling of the full extent of the varix with the embolization endpoint being minimal filling of the afferent vein/portal vasculature. The injection of a sclerosing agent can be performed with or without the use of a microcatheter for more selective injection. The authors suggest advancing a microcatheter as deep as possible into the varix and injecting the sclerosant through the microcatheter. This provides the benefit of selective delivery of the sclerosant into the varix and minimizing the volume used, as well as minimizing the risk of balloon rupture when the sclerosant comes in close proximity to the balloon. In addition, leaking collateral veins, such as the inferior phrenic or paravertebral veins, are commonly present and prevent full opacification of gastric varices. These veins are occluded using coils or gelfoam pledgets through a selectively catheterized microcatheter. This would modulate flow in the veins in an effort to concentrate the sclerosant at the varix and minimize nontarget distribution in the portal or systemic vasculature. If the patient has more than one shunt (eg, gastroduodenal and gastropericardiophrenic shunts), an additional occlusion balloon, usually from

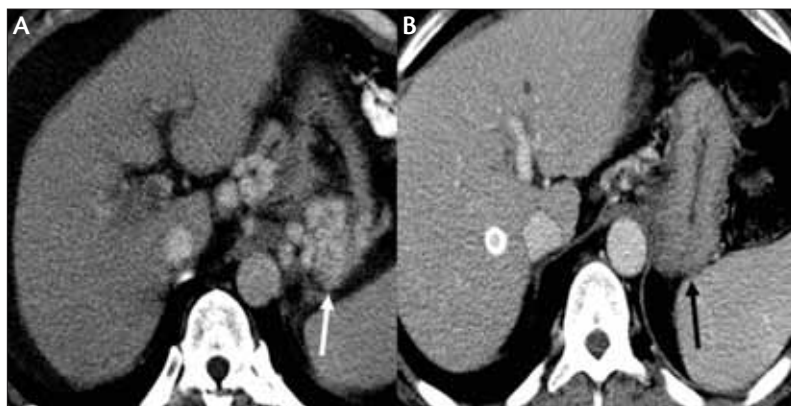


Figure 5. Preprocedure CTA showing enhancing gastric fundal varices (A). A CTA 2 weeks postprocedure showing lack of enhancement and obliteration of the varices (B).

the jugular approach, is usually needed to occlude the second shunt.

Ethanolamine oleate iopamidol (EOI), sodium tetradecyl sulfate (STS) as foam, and n-butyl-2-cyanoacrylate are examples of agents that have been frequently used in therapy. EOI is the original agent used for this procedure and is the agent of choice in Asia. A 5% EOI solution consists of a mixture of 10% EOI and the same dose of a contrast medium. EOI causes hemolysis in the blood vessels. As a result, free hemoglobin is released, which may cause renal tubular disturbances and acute renal failure. To prevent renal insufficiency, 4,000 units of haptoglobin are administered intravenously and combine with free hemoglobin. Other complications associated with the use of EOI, including cardiogenic shock, pulmonary edema, and disseminated intravascular coagulation, have also been reported.^{13,15,16} Therefore, if possible, < 40 mL of EOI should be used in each procedure. Recently, other agents have

been used in the United States, namely STS as foam. STS (3%) is mixed with lipiodol and gas (air or CO₂) in a 2:1:3 ratio.¹⁷ The foam has the potential advantage of minimizing the dose of the sclerosant and may provide better contact with the variceal wall.

Experience with this agent is limited, and no long-term results are available.

Follow-up with CTA, magnetic resonance imaging, or endoscopic ultrasound before discharge is obtained to confirm obliteration of the varices and for the additional possible need for further interventions (Figure 5). Periodic follow-up with endoscopy is recommended to evaluate for recur-

rence or development of new gastric or esophageal varices.

OUTCOMES

Procedural outcomes are summarized in Table 2. Technical success has been reported in 84% to 100% of cases. The complete obliteration rate ranges from 86% to 100%.^{11,13,16-21} Patients with partial obliteration may undergo subsequent BRTO procedures to obtain full obliteration. Failure to obliterate the varix can be attributed to several factors:

1. The gastrosplenic shunt may not be fully occluded with the balloon catheter due to the large shunt size and rapid flow through the shunt. Some authors suggest partial splenic embolization to decrease the flow in the shunt and reattempting the BRTO procedure 2 weeks later.
2. Lack of a defined gastrosplenic or gastrocaval shunt or a very tortuous shunt, which may prevent catheterization and balloon occlusion.

TABLE 2. PROCEDURAL OUTCOMES

Investigator	No. of Patients	Technical Success (%)	Rebleeding (%)	Complete Obliteration (%)
Cho et al ¹⁸	49	84	0	100
Hiraga et al ¹³	34	97	3	91
Kitamoto et al ²¹	24	96	9	88
Arai et al ¹⁹	11	100	9	91
Ninoi et al ²⁰	78	87	0	95
Kanagawa et al ¹¹	32	100	0	97
Sonomura et al ²²	14	100	0	86
Sabri et al ¹⁷	21	90	0	88

3. Extensive leaking collateral veins that prevent full opacification of the varix. Selective catheterization of these collaterals may not be possible. Slow nonselective injection of gelfoam pledgets may help decrease flow into these collaterals and further opacify the varix. Advancement of a microcatheter deep into the varix may bypass these leaking collaterals; however, this can be difficult to perform without the varix being opacified.

4. Inadequate volume of sclerosant was administered. As stated previously, the endpoint should be filling of the entire varix and visualization of the afferent vein.

Recurrence of gastric varices is rare, and rebleeding from gastric varices after technically successful procedures is uncommon (0%–9%). However, worsening of esophageal varices has been reported in up to 68% of patients in one series, with a median follow-up of 15 months, and in 39% and 52% at 3 and 5 years, respectively, in another series. Bleeding from esophageal varices has been reported in 10% to 32% of patients.^{13,18} BRTO has been used to treat symptoms of encephalopathy. The reported efficacy for the treatment of gastric varices and hepatic encephalopathy is 87% to 100%, with a relapse rate of 0% to 10%.^{11,15,23} The overall cumulative survival rates were 90%, 75%, 68%, and 55% at 1, 3, 5, and 7 years after BRTO, respectively.¹³

CONCLUSION

BRTO is a safe, effective, and established technique to treat and prevent gastric variceal bleeding and improve hepatic encephalopathy symptoms. Knowledge of the anatomy and technical aspects of this procedure are crucial in obtaining the desired results. ■

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