

Endovascular Transvenous Obliteration of Bleeding Gastric Varices

An overview of the preprocedural workup and technique involved in balloon-occluded retrograde transvenous obliteration, as well as alternative occlusion strategies.

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Gastric varices may develop from portal hypertension or splenic vein occlusion, so-called left-sided portal hypertension. Medical and endoscopic refractory bleeding or hepatic encephalopathy are complications that may occur from enlargement of these portosystemic collaterals.

Unlike esophageal variceal bleeding, gastric variceal bleeding is more difficult to control endoscopically due to size and high flow and may bleed at lower portosystemic pressure gradients.^{1,2} Balloon-occluded retrograde transvenous obliteration (BRTO) of gastric varices is now an established endovascular technique to directly treat bleeding vessels with high technical success rates and good clinical outcomes.³⁻⁶ Adjunctive and alternative endovascular techniques to decompress gastric varices include transjugular intrahepatic portosystemic shunts (TIPS) and splenic reduction through particle embolization. Transvenous gastric variceal obliteration is advantageous in patients with elevated MELD scores and encephalopathy, who would otherwise be poor candidates for TIPS.^{2,7}

In this article, we discuss our preprocedural approach and workup, procedural technique, possible complications/adverse effects, and utilization of alternative outflow occlusion techniques including coil-assisted and plug-assisted transvenous obliteration.

CLINICAL EVALUATION AND WORKUP

Upon initial consultation, if not already available, we perform contrast-enhanced CT for delineation of the portal venous and shunt anatomy.⁸ In some circumstances, gastric varices develop secondary to chronic splenic vein occlusion. If technically feasible, we attempt splenic vein recanalization from a transhepatic or transsplenic approach. If this is unsuccessful, splenic reduction through particle embolization would be performed, as splenectomy is not typically desired given the potential morbidity and challenges of surgically negotiating extensive perisplenic collaterals. In addition, imaging may demonstrate portal venous occlusion or stenosis as the etiology of portal hypertension, in which case, treatment would be directed toward potentially correcting the portal venous obstruction and, if necessary, following with embolization or obliteration of the gastric varices.

If splenic vein or portal vein stenosis or occlusion is absent, then we evaluate the CT for the presence of a gastrosplenic or gastrocaval shunt. Typical laboratory workup and clinical resuscitation is performed, and abnormalities are corrected as necessary. As described in previous reports, resuscitation should not be over-aggressive, as this may precipitate bleeding due to increasing portal pressure.^{1,9,10} Patients who have large-

volume ascites accumulation or concomitant esophageal varices are potentially at risk for exacerbation of symptoms after occlusion of the large decompressing collateral, which can be as high as 27% at 1 year and 58% at 3 years. Appropriate consultation and discussion about this risk is warranted prior to variceal obliteration.^{3,7}

TECHNIQUE

Given the trajectory of the gastrorenal shunt anatomy, we favor a transfemoral approach, although a transjugular approach is also feasible. From our initial CT evaluation, the size of the gastrorenal or gastrocaval shunt is ascertained to select the size of balloon occlusion catheter that is needed.

A long sheath that is one or two French sizes larger than the outer diameter of the balloon occlusion catheter is typically selected. This allows for venography around the balloon catheter and permits continuous saline infusion, both to keep the lumen open and to prevent thrombus formation during the balloon inflation dwell period.

Catheterization of the gastrorenal or gastrocaval shunt is typically performed with a 5-F Cobra or other angled selective catheter. Due to flow dynamics, venography is performed to properly delineate the shunt anatomy and is improved with occlusion of the efferent vein. A stiff 0.035-inch wire (eg, Rosen wire, Cook Medical) is advanced into the shunt to provide enough stiffness and working length to track the balloon occlusion catheter into the shunt. The selection of a specific balloon occlusion catheter depends on the size of the venous shunt, which can be estimated on the preprocedural CT or measured on initial venography. The shunt will usually be tortuous and demonstrate varying segments of larger and smaller diameters but is typically smallest nearest its confluence with the renal vein.

When feasible, we use a 7-F Python catheter (Applied Medical) with a maximum balloon diameter of 14 mm. If a larger-diameter balloon is necessary, we use the Coda balloon catheter (Cook Medical), which has a maximum inflation diameter up to 45 mm. The drawback of larger balloon occlusion catheters is the need for a larger sheath size and its relative stiffness, which may prove difficult to track into the shunt.

After placing the balloon occlusion catheter, venography is performed to confirm occlusion of the efferent vein and determine the efferent venous anatomy. The

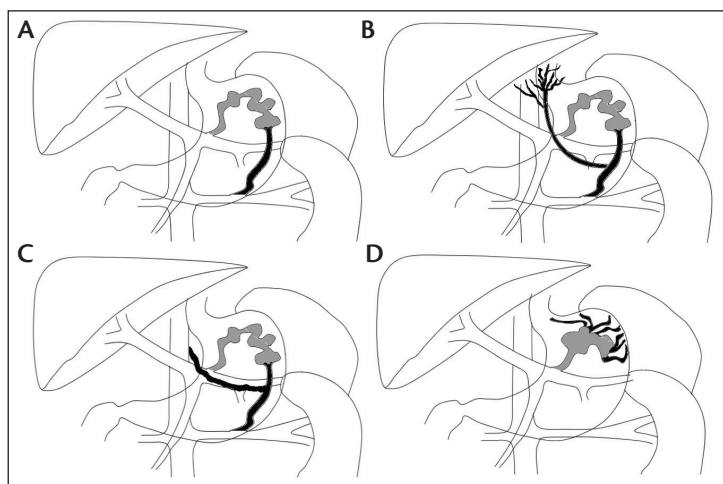


Figure 1. Classification of efferent venous drainage types. Type A has a single efferent outflow vein, typically a gastrorenal shunt (A); type B demonstrates additional smaller efferent outflow veins, typically peridiaphragmatic (B); type C has both a gastrorenal and gastrocaval shunt (C); and type D demonstrates multiple small efferent collaterals without a large gastrorenal or gastrocaval shunt (D).

classification of venous outflow has previously been described¹¹ and depends on the number and type of efferent veins (Figure 1). Type D anatomy, in which no large gastrorenal or gastrocaval shunt is present, is usually the only type that would not be feasible to treat through a traditional, nontransplenic, or nontranshepatic approach, as the drainage pathway into the systemic circulation is through multiple small branches.

In type B outflow anatomy, smaller collateral peridiaphragmatic pathways may be present. These may compete and prevent adequate distribution of the obliterative material or serve as a potential source of nontarget systemic embolization. Therefore, these branches are usually embolized prior to treatment. Pushable coils are adequate to occlude the small collateral venous pathways (Figure 2). The gastric varix is catheterized as deeply as possible with a coaxial microcatheter. We have found that larger microcatheters, such as the 2.8-F Progreat device (Terumo Interventional Systems), do not fit through the lumen of the 7-F Python catheter. Therefore, we use a smaller-profile microcatheter, such as the 2.4-F Direxion device (Boston Scientific Corporation).

The choice of sclerosant material is operator and institution dependent. Different materials and mixtures have proven to be effective.^{1,4,12,13} In the classic technique, 5% ethanolamine oleate iopamidol (10% ethanolamine oleate mixed equally with iodinated contrast) is used; however, this carries potential adverse effects,

including hemolysis-induced renal tubular dysfunction and insufficiency.¹⁴ Haptoglobin is a hemoglobin-binding agent that is administered during infusion to prevent renal dysfunction, but it is not commercially available for use in humans in the United States.¹⁰

Other sclerosing and embolic agents include Gelfoam (Pfizer, Inc.) slurry, n-butyl-2-cyanoacrylate, and foam sotradecol sulfate. We have achieved good results using sodium tetradecyl sulfate (STS) foam in a mixture with either Lipiodol (Guerbet LLC) or iodinated contrast and CO₂ or room air. The typical mixture ratio is one part Lipiodol, two parts 3% STS, and three parts CO₂ or room air (a 1:2:3 ratio). Lipiodol provides better radiographic visualization but can theoretically cause balloon rupture and could potentially lead to nontarget embolization. We found that iodinated contrast provides adequate visualization with a ratio of 3:2:3 or 3:2:2 of CO₂, 3% STS, and Visipaque 320 (GE Healthcare). In addition, utilizing room air rather than CO₂ provides a more sustainable foam solution without any reported adverse effects and potentially increased efficacy, which may be related to the material's ability to better remain as a foam.

During delivery of the embolization or obliterative solution, the challenge is to avoid and minimize entry into the afferent portal system. In this regard, careful attention should be given to visualizing the depth of sclerosant delivery and, when necessary, retracting the microcatheter. Filling of the large gastric varices should be directly visualized, and the technical endpoint is achieved when the sclerosant or embolic material is seen to approach or just enter into the afferent portal branch. Cone-beam CT can potentially be helpful in evaluating the degree of embolization and determining whether the endpoint has been reached.¹⁵ Given the high stakes of preventing portal venous entry, the use of Lipiodol may be preferred due to its higher radiopacity.

POSTPROCEDURAL CARE AND COMPLICATIONS

After satisfactory delivery of the treatment agent, we leave the occlusion catheter with the balloon inflated and sheath in place for at least 4 to 6 hours or overnight. Overnight placement of the inflated balloon is a conservative approach and theoretically reduces risk of nontarget embolization, but data and

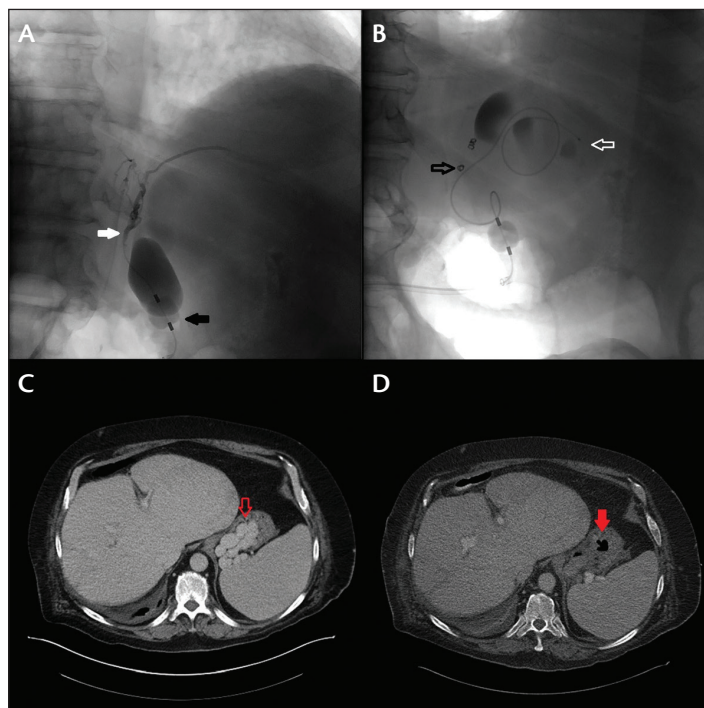


Figure 2. Fluoroscopic images from a BRTO procedure and CT the following day. Small peridiaphragmatic efferent veins are visible (solid white arrow), and a 7-F Python balloon occlusion catheter was inflated (solid black arrow) (A). The peridiaphragmatic vein was occluded with small pushable coils (hollow black arrow), with the microcatheter positioned deep into the gastric varix (hollow white arrow) (B). Contrast-enhanced portal venous phase CT before (C) and 2 days after BRTO (D) demonstrates the absence of contrast enhancement with foam sclerosant persisting in the large treated varices.

experience suggest a low risk of this complication with early balloon removal, showing no significant difference in clinical efficacy.^{2,16} Normal saline is infused through the sheath to prevent thrombus formation, and the sheath is typically retracted out of the left renal vein. The patient returns the next day for catheter and sheath removal. CT (without contrast and venous phase) or limited catheter venography is sometimes performed prior to sheath removal to assess for adequate variceal coverage.

When performed with diligence, BRTO is safe and efficacious. The major complication rate is approximately 2.6%, defined as portal/splenic vein thrombosis, systemic venous thrombosis, and pulmonary embolism.¹⁷ Although not an immediate complication, aggravation of esophageal varices is a known side effect of BRTO,^{1,7,17} due to corresponding elevation of the hepatic venous pressure gradient, requiring careful follow-up including endoscopy.¹⁸

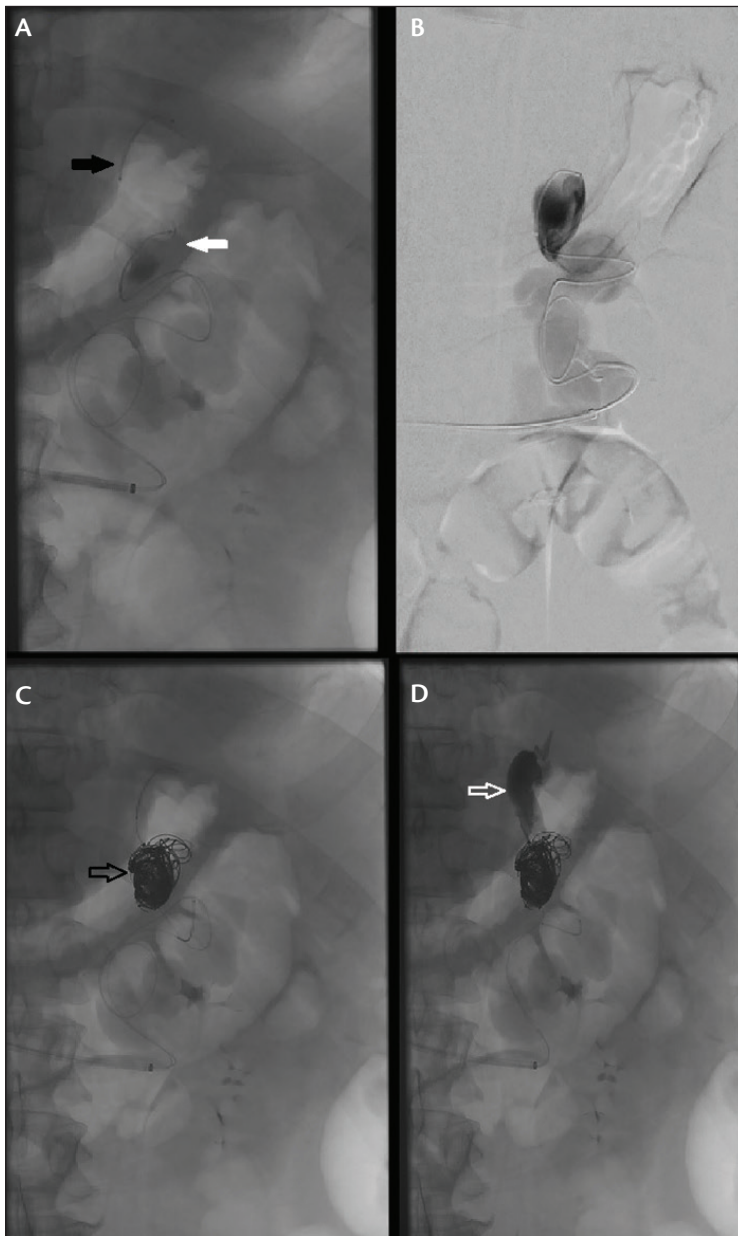


Figure 3. Coil-assisted transvenous gastric variceal obliteration. Dual microcatheters were positioned (A), and a large occlusive nest of coils was deployed through the microcatheter closer to the efferent venous outflow (hollow black arrow) (C). Digital subtraction angiography performed within the varix prior to coil embolization (B). After confirming occlusion of the efferent outflow, as demonstrated by stagnation of injected contrast (hollow white arrow), sclerosant or embolic material may be delivered (D).

ALTERNATIVE VENOUS OUTFLOW OCCLUSION STRATEGIES

If a balloon occlusion catheter cannot be used to occlude the efferent shunt (eg, if an appropriate-sized

balloon catheter is unavailable or the catheter cannot be tracked into the tortuous shunt to properly occlude flow), large diameter and length coils or vascular plugs can be used.^{19,20} The benefit of immediate efferent shunt occlusion obviates the need for prolonged balloon occlusion, which may save on the associated costs, resources, and potential complications of indwelling sheaths, such as bleeding or thrombosis. The drawback is that for the small percentage of cases in which gastric variceal bleeding recurs or is not initially fully obliterated, reaccess to the varix is subsequently blocked, and alternate approaches would be necessary, such as transhepatic or transplenic access through the afferent vein.

Coil-assisted retrograde transvenous obliteration utilizes a single-access sheath with two coaxial catheters. One catheter is used to catheterize deep into the gastric varix, while the other is left in a position closer to the efferent vein. After deploying multiple coils to block the efferent vein, the degree of occlusion is confirmed with injection of the catheter positioned within the gastric varix. Once appropriate occlusion is confirmed, the embolic or sclerosant material is delivered in a similar fashion as the traditional BRTO technique (Figure 3). Plug-assisted retrograde transvenous obliteration shares a similar technique as vascular coils with utilization of large vessel occlusive vascular plugs. Both techniques may require the use of a second access site to facilitate correct catheter positioning. The plug-assisted retrograde transvenous obliteration technique utilizes an appropriately sized Amplatzer vascular plug II (St. Jude Medical, Inc.).

Typically, flow occlusion is not immediate, and therefore, the plug is left for a period of 5 to 10 minutes, at which point, the degree of occlusion is evaluated.²⁰ If contrast continues to flow or leak through or around the plug, additional embolization may be performed with Gelfoam slurry or placement of vascular coils. One recent single-center retrospective study revealed that

the plug-assisted retrograde transvenous obliteration technique demonstrated more frequent recurrence of gastric varices during long-term follow-up compared with BRTO.²¹

More recently, combined afferent and efferent venous occlusive approaches have been utilized to embolize gastric varices, including the “trap” obliteration technique.²²⁻²⁴ Theoretically, this may improve safety by not only occluding the efferent veins entering into the systemic circulation through the traditional BRTO technique, but also the afferent veins such as the left or posterior gastric veins, to prevent the complication of portal venous entry and subsequent thrombosis. It is unclear whether this combined, dual-access approach may improve on the safety and clinical efficacy profile of an already highly effective technique.

CONCLUSION

Transvenous obliteration is now an established minimally invasive endovascular technique that is effective and durable in treating gastric variceal bleeding due to portal hypertension. Many variations in technique and approach have been described, including the use of different embolic or oblitative solutions and alternative occlusive strategies such as vascular plugs and coils. These various options allow for more widespread adoption of this treatment by offering techniques that overcome the limitations of resource and product availability. ■

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