



Gelatin Sponge without Sclerosant During Plug-Assisted Retrograde Obliteration for Gastric Varices: A Single Center Retrospective Study

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Abstract

Purpose The aim of the study is to evaluate the safety and effectiveness of using gelatin sponge without sclerosant during plug-assisted retrograde transvenous obliteration (PARTO) for variceal hemorrhage.

Methods This is an institutional review board-approved retrospective analysis of 45 consecutive patients (34 men, 11 women; mean age, 45 years; range 16–70 years) who underwent RTO between 2019 and 2025 for gastric variceal hemorrhage. The procedure involved the use of vascular plugs in conjunction with absorbable gelatin sponge without the addition of sclerosants. Clinical and laboratory data were reviewed to assess procedural outcomes, including technical and clinical success rates, as well as associated complications. Patients were followed for a median of 3 years (range 3–5 years).

Results Technical success—defined as occlusion of the gastrosplenic shunt and complete opacification of the gastric varix with gelatin sponge slurry—was achieved in all 45 patients (100%). Clinical success, defined as the absence of upper gastrointestinal bleeding during the follow-up period, was observed in all patients. Follow-up CT obtained within 1 week after RTO showed complete thrombosis of gastric varices and portosystemic shunts in all patients (100%). Death due to other causes occurred in five patients.

Among the five patients who died during follow-up, the median time to death was 18 months. There were no immediate procedure-related complications. During the follow-up period, all patients demonstrated sustained clinical success, with a median follow-up duration of 3 years.

No cases of upper gastrointestinal bleeding or hepatic encephalopathy were observed throughout the follow-up period.

Conclusion The use of gelatin sponge without sclerosant during PARTO is safe and effective for the management of gastric variceal hemorrhage, with durable long-term outcomes.

Keywords

- ▶ portal hypertension
- ▶ gastric varix
- ▶ retrograde transvenous obliteration
- ▶ Gelfoam
- ▶ sclerosants
- ▶ gastrosplenic shunt

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Introduction

Gastroesophageal varices represent a serious complication of portal hypertension. Bleeding from gastric fundal varices is particularly life-threatening and often resistant to conventional pharmacological or endoscopic treatment.¹ In scenarios where standard therapy proves inadequate, interventional radiology procedures, such as transjugular intrahepatic portosystemic shunt (TIPS) and retrograde transvenous obliteration (RTO), are considered.^{2,3} RTO is specifically considered in patients with hepatic encephalopathy and poor liver function.

An RTO procedure involves outflow occlusion of the gastrosplenic shunt (GRS) using balloon-occluded retrograde transvenous obliteration (BRTO), a vascular plug-assisted retrograde transvenous obliteration (PARTO), or coil-assisted retrograde transvenous obliteration (CARTO), followed by embolization of gastric varices with sclerosant foam mixed with lipiodol. While BRTO is clinically effective, it has several drawbacks, including long procedural durations due to balloon occlusion and reliance on sclerosants, which are associated with systemic side effects.^{1,4-10} PARTO and CARTO techniques aim to enhance procedural efficiency.

This study investigates the use of a modified PARTO procedure—relying solely on gelatin sponge (Gelfoam) embolization without the use of sclerosants—for the treatment of gastric variceal hemorrhage.

Methods

This retrospective study was approved by our institutional review board. All patients provided consent for the procedure.

Patients

Forty-five ($n = 45$) consecutive patients with gastric variceal hemorrhage who underwent plug-assisted RTO with gelatin sponge as the embolic material between March 2015 and January 2019 were included in this study (► **Table 1**). All patients had associated portal hypertension and 10 patients had a history of hepatic decompensation, including ascites or encephalopathy. All 45 patients underwent contrast-enhanced computed tomography (CECT) of the abdomen, which included arterial, portal venous, and delayed venous phase acquisitions. Imaging revealed dilated portal and splenic veins, gastric varices, splenomegaly, and recanalized paraumbilical veins, indicating elevated portal pressures and warranting shunt obliteration.

Of the 45 patients, 10 (22.2%) underwent RTO during an acute bleeding episode, whereas 35 (77.8%) were treated electively after hemodynamic stabilization. In the elective group, the procedure was typically performed approximately 5 days after the bleeding event, allowing for prior endoscopic evaluation, availability of the operating suite, requisite investigations, and institutional approval processes. Patients had either actively bleeding gastric varices or a documented history of prior variceal hemorrhage unresponsive to standard pharmacologic or endoscopic therapy. The

Table 1 Patient characteristics

Parameter	Value
Number of patients	45
Mean age (years)	46.8
Age range (years)	16–70
Sex distribution	34 males (75.6%), 11 females (24.4%)
Etiology of cirrhosis	Alcoholic (22), Viral (HBV/HCV – 8), NASH (10), Cryptogenic (5)
Child-Pugh class	A (10), B (25), C (10)
MELD score (mean ± SD)	14.2 ± 3.1
Primary indication	Upper GI bleeding from gastric varices
Shunt anatomy	Gastrosplenic (100%)
Access route	Retrograde via renal vein
Embolic agents used	Amplatzer vascular plug (AVP); coils in adjunctive cases
Gelfoam used	Yes, in all patients (no sclerosant)
Technical success	100% (45/45 cases)
Immediate complications	None in 87% (39/45), mild-to-moderate in 13% (6/45)
Mortality (Follow-up)	Five deaths (unrelated to procedure)

Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; GI, gastrointestinal bleeding; NASH, Nonalcoholic Steatohepatitis.

GRS anatomy was confirmed in all patients using multiphasic CECT. Baseline clinical profiles, laboratory data, Child-Pugh and MELD scores, and procedural findings were obtained from hospital electronic medical records (EMRs). Patients with uncorrectable coagulopathy, extensive portal vein thrombosis, or advanced malignancy were excluded.

Technique

The authors used the two-puncture technique, one access for the deployment of the plug and another to navigate the gastro-renal shunt (GRS) and embolize the varices (► **Fig. 2**).

A 6F vascular sheath was introduced into the right common femoral vein. The left renal vein was cannulated using a 5F SIM 1 catheter and an angled guidewire. Upon successful navigation of the GRS, the 6F sheath was exchanged for a 10F sheath over a 0.035" stiff guide wire and positioned at the ostium of the GRS.

Subsequently, a 5F catheter and a microcatheter were advanced into GRS. A vascular plug (Amplatzer Vascular Plug, Abbott Cardiovascular, United States) was deployed across the GRS to occlude the outflow of the shunt and prevent systemic outflow of embolizing material. In cases where a plug was insufficient to occlude the GRS, additional detachable coils were deployed in eight patients—two in the



Fig. 1 Technique for retrograde transvenous obliteration of varices in our institute. A 6-year-old girl with recurrent hematemesis, whose upper gastrointestinal endoscopy revealed *GOV-1* varices, and contrast-enhanced CT demonstrated *extrahepatic portal venous obstruction with portal cavernoma* and a 6-mm *gastrorenal shunt*. (A, B) The left renal vein was cannulated using a 5-Fr SIM 1 catheter through a 6-Fr sheath. (C) 10-Fr sheath placement at the mouth of the gastrorenal shunt with plug deployment. (D) A 5-Fr catheter and a microcatheter were advanced into GRS with subsequent embolization. GRS, gastrorenal shunt.

emergent group and six in the elective group to ensure complete occlusion. The gelatin sponge slurry was prepared by mixing absorbable gelatin sponge fragments with iodinated contrast material and saline to form a paste-like consistency. This embolic material is injected slowly through the microcatheter until complete opacification and stasis within the varices were achieved. The procedural steps of plug-assisted retrograde transvenous obliteration using gelatin sponge without sclerosant are illustrated in **Fig. 1**.

Final venography was performed to confirm occlusion of the GRS and patency of the renal vein. Hemostasis was

achieved at the puncture site, and patients were monitored post-procedure for 24 to 48 hours.

Follow-Up

All patients go through a CECT within 1 week after the procedure to document immediate thrombosis of the GRS and gastric varices. Subsequent clinical follow-up occurred at 1 month, 6 months, 12 months, and annually thereafter, up to a median of 36 months (range 12–60 months). Surveillance involved clinical assessment (history and physical examination), laboratory work-up (liver function, renal function),

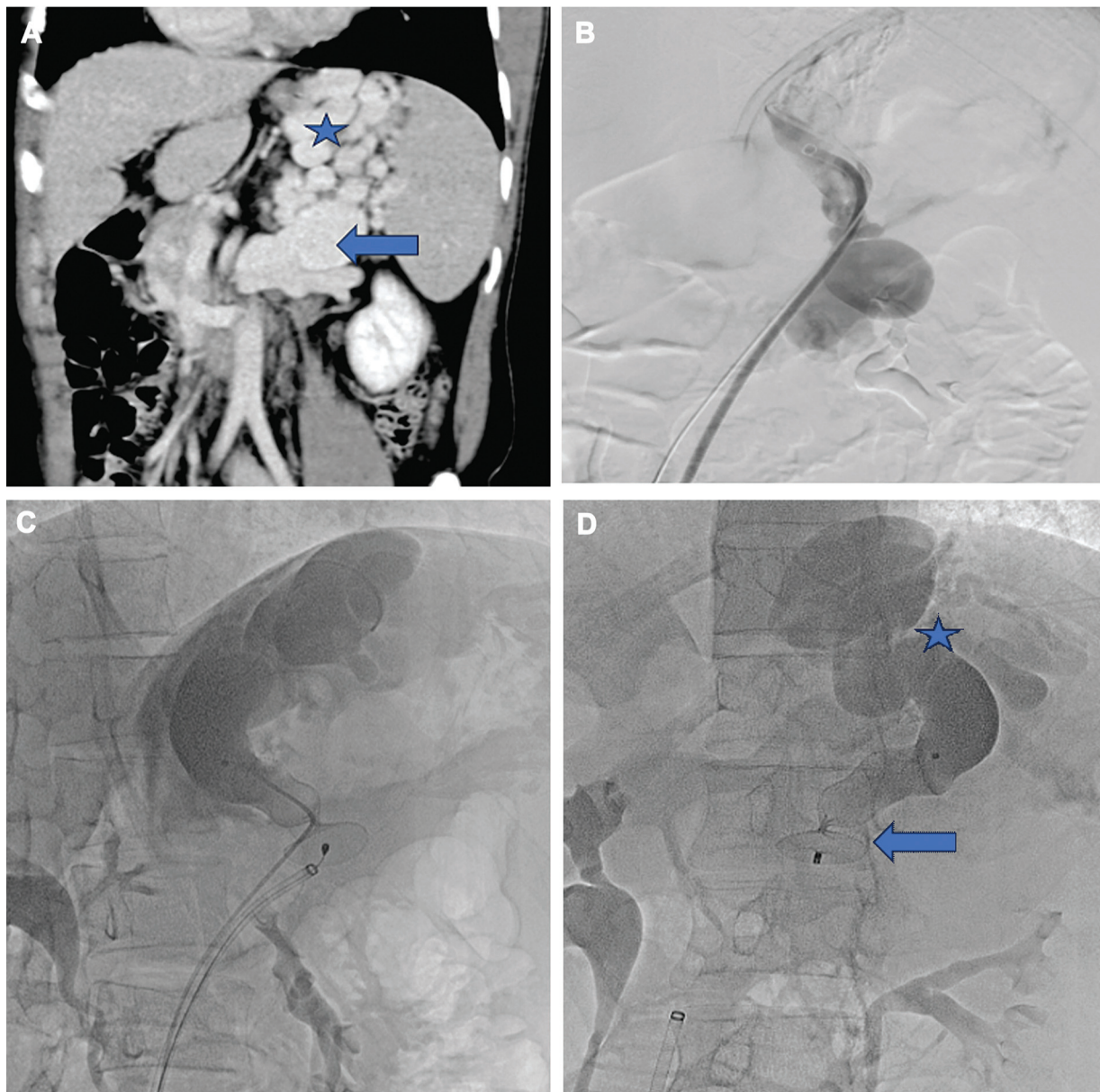


Fig. 2 Plug-assisted transvenous obliteration of GRS: A 42-year-old male with chronic alcohol-related liver disease presented with recurrent hematemesis. He was Child Pugh B, and the MELD score was 16. Upper gastrointestinal endoscopy revealed GOV-2 varices, CT demonstrated features of portal hypertension and a 14-mm gastrorenal shunt. (A) Large gastrorenal shunt (arrow) draining the gastric varices (blue asterisk). (B) Selective cannulation of the gastrorenal shunt with contrast opacification of the distal part of the shunt (close to the renal vein). (C) 5-Fr catheter proximal to the plug with gelatin sponge embolization through the catheter showing stasis. (D) Post-embolization images showing vascular plug (arrow) distally with gelatin sponge-embolized gastric varices (blue asterisk) proximal to the plug. GRS, gastrorenal shunt.

and radiologic imaging (Doppler ultrasound). Endoscopy was performed in selected cases to assess residual or recurrent varices.

Statistical Analysis

Technical success was defined as occlusion of the GRS and complete opacification of the gastric varix with gelatin sponge slurry. Clinical success was defined as the absence of rebleeding from gastric varices. Variceal regression and thrombosis were confirmed radiologically or endoscopically.

Descriptive statistical methods were applied to patient demographics, procedural data, and outcomes. Continuous variables such as age and MELD scores were expressed as

mean \pm standard deviation. Categorical data, such as complication rates and variceal obliteration, were presented as proportions. No inferential statistics (e.g., *p*-values, regression analysis) were used due to the single-arm retrospective design. Data integrity was validated against EMR entries and procedural logs.

Results

Technical success was achieved in all 45 patients (100%). Clinical success was also 100% with no patient experiencing recurrence of upper gastrointestinal hemorrhage during the follow-up.

Table 2 Comparative table with similar studies

Study	Technique	Sample size	Technical success	Clinical success	Complications	Follow-up
Current study	Retrograde transvenous obliteration with Gelfoam	45	100%	100%	None	3–5 y
Gwon et al (2013)	PARTO + Gelfoam	17	100%	100%	None	422 d
Kim et al (2016)	PARTO	24	100%	95.8%	1-Encephalopathy	1 y
Lee et al (2014) ¹⁸	CARTO	19	100%	100%	None	15 mo
Pelle et al (2024)	PARTO	38	100%	94.7%	1-Plug Migration	2–4 y

Abbreviations: CARTO, coil-assisted retrograde transvenous obliteration; PARTO, plug-assisted retrograde transvenous obliteration.

Post-procedure contrast-enhanced CT demonstrated complete thrombosis and obliteration of the gastric varices, with the vascular plug positioned securely at the GRS. The embolized varices appeared as hyperdense foci, corresponding to gelatin sponge deposition, a characteristic post-RTO imaging feature. Additional findings included the absence of residual opacification of the shunt, preserved renal vein patency, and stable surrounding structures, consistent with successful variceal and shunt occlusion.

No patient experienced immediate post-procedure complications requiring intervention. Among the five patients who died during the follow-up, two succumbed to acute cardiopulmonary events, two died from complications related to progressive hepatic dysfunction, and one patient died due to renal failure with superimposed sepsis. Importantly, no patient exhibited variceal rebleeding or new-onset encephalopathy, and there were no cases of renal impairment or access site complications.

Discussion

The management of gastric varices, particularly in the setting of acute or recurrent upper gastrointestinal bleeding, remains a significant clinical challenge. These varices are less common than esophageal varices but have a higher propensity for life-threatening hemorrhage. Conventional pharmacologic and endoscopic interventions frequently fail in cases of gastric variceal bleeding, prompting reliance on interventional radiologic techniques such as TIPS and RTO.^{11,12} RTOs are routinely performed using BRTO, and sclerosant foam mixed with lipiodol or contrast material is used to occlude the varices.

BRTO is limited by its procedural complexity, including the need for prolonged balloon occlusion, the potential for balloon rupture, and the systemic side effects of sclerosants. These agents are known to cause hematuria, pyrexia, renal dysfunction, and allergic reactions. Moreover, prolonged procedural time and overnight balloon retention can be poorly tolerated in emergency settings.^{1,8,13–15}

To address these limitations, variations such as PARTO and CARTO have been developed. These approaches reduce procedure duration and eliminate the need for indwelling balloon catheters. Our study focuses on a further modifica-

tion—RTO of varices using gelatin sponge without any sclerosant. The gelatin sponge, serves as a mechanical embolic material and avoids the systemic effects of chemical sclerosants.^{1,8,13–15}

Our study observed a 100% technical success rate, defined as complete occlusion of the GRS and embolization of gastric varices. This is consistent with other studies on PARTO and CARTO using sclerosants.^{9,13} Importantly, our cohort demonstrated a high clinical success rate (with no recurrent variceal bleeding) during a median follow-up period of 3 years. The absence of sclerosants did not negatively impact the durability of embolization, suggesting that gelatin sponge alone is sufficient for long-term variceal obliteration in appropriately selected patients. When compared with earlier studies, such as those by Kim et al^{13,16} and Gwon et al¹³ Lee et al,¹⁷ and Pelle et al,¹⁶ which used sclerosants, our results are comparable or even superior in terms of technical and clinical success. These findings imply that omitting sclerosants not only maintains efficacy but also enhances safety. Furthermore, eliminating the need for sclerosants reduces costs, preparation complexity, and potential side effects—an important consideration in resource-limited healthcare settings. A comparison of technical success, clinical outcomes, and complication rates between the present study and previously published series is summarized in **Table 2**.

A notable strength of our study is the inclusion of both elective and emergent clinical scenarios, offering real-world evidence of this technique’s feasibility. The simplicity of the procedure also enabled prompt intervention in acute settings without compromising safety. We observed no immediate procedure-related complications and no cases of post-procedure hepatic encephalopathy.

However, certain limitations must be acknowledged. The retrospective design limits control over variables and may introduce selection bias. The absence of a control group treated with sclerosants precludes a direct comparative analysis. Additionally, our sample size, while larger than several previous studies, remains relatively modest. Our follow-up did not include consistent longer-term imaging to assess persistence of variceal occlusion. Imaging is not the method of choice for variceal detection or follow-up and is associated with high cost and potential harmful radiation to patients. Despite these limitations, our findings provide the

potential of gelatin sponge-only PARTO as a simplified, effective approach to treating gastric varices.

In conclusion, our study adds to the growing body of evidence supporting non-sclerosant-based interventions for gastric varices. PARTO with gelatin sponge alone offers a safe and effective therapy for gastric variceal hemorrhage. It is particularly advantageous in emergency settings and among patients at high risk for sclerosant-related complications. Future multicenter prospective trials are recommended to validate these findings and establish standardized guidelines for non-sclerosant RTO protocols.

Conclusion

Plug-assisted retrograde transvenous obliteration using absorbable gelatin sponge without sclerosant is a safe, effective, and durable treatment option for gastric variceal hemorrhage. This modified technique demonstrated excellent technical and clinical success rates with sustained long-term control of bleeding and no procedure-related major complications. By eliminating the use of sclerosants, this approach reduces systemic adverse effects, procedural complexity, and cost, making it particularly suitable for emergency settings and resource-limited institutions. Although limited by its retrospective design and lack of a comparative control group, the results support gelatin sponge-only PARTO as a viable alternative to conventional sclerosant-based techniques. Larger prospective and multicenter studies are warranted to further validate these findings and to help establish standardized non-sclerosant RTO protocols

Ethical Approval

This retrospective study was approved by the Institutional Review Board and was conducted in accordance with the Declaration of Helsinki. Informed consent for the procedure was obtained from all patients or their legal guardians, and patient confidentiality was strictly maintained.

Conflict of Interest

None declared.

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