

CASE REPORT

A case of unsuccessful obliteration of percutaneous transhepatic gastric varices using the IMPEDE embolization plug

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Key Clinical Message

Embolization with IMPEDE embolization plug cannot be confirmed on site. Therefore, we propose that the diameter of the device selected be up to 50% larger than the vein diameter to prevent embolization failure and recanalization.

Abstract

Balloon-occluded retrograde transvenous obliteration and percutaneous transhepatic obliteration (PTO) are performed for treating sporadic gastric varices. IMPEDE embolization plug has been recently developed for these procedures; however, no studies have reported its use. This is the first report on its use in PTO of gastric varices.

KEYWORDS

balloon-occluded retrograde transvenous obliteration, case report, IMPEDE embolization plug, percutaneous transhepatic obliteration, peripheral embolization, shape memory polymer

1 | INTRODUCTION

Balloon-occluded retrograde transvenous obliteration (BRTO) and percutaneous transhepatic obliteration (PTO) are established procedures for treating sporadic gastric varices. Materials such as n-butyl-2-cyanoacrylate (NBCA), coils, and 5% ethanolamine oleate (EO) are used for embolization. Nonetheless, complications may arise, such as extrusion of the embolization material and resumption of blood flow. Coils are commonly used to permanently occlude peripheral vessels. However, several coils are often required to achieve complete occlusion, which leads to increased procedural costs and radiation

exposure.¹ In addition, recanalization of a previously occluded vessel can occur in up to 20% of patients, which requires retreatment.²

An ideal peripheral occlusion device should minimize the time to achieve complete occlusion, require only one device to achieve stable vessel occlusion, minimize the potential for recanalization, and be delivered with minimal invasiveness.³

Shape memory polymer (SMP) foams have the unique ability to be stored in a compressed geometry and subsequently expand to fill large volumes upon contact with circulating blood.⁴ They can expand up to 10 times their crimped diameter and allow occlusion of vessels with a

single device. There have been multiple reports of SMP use in arteries⁵; however, none on its use in PTO/BRTO of gastric varices. Here, we report a PTO procedure for gastric varices using SMP-based IMPEDE embolization plug (COSMOTEC).

2 | CASE PRESENTATION

A 61-year-old man diagnosed with fatty liver cirrhosis 6 years earlier, developed gastric varices, which were detected during outpatient follow-up. BRTO was considered; however, contrast-enhanced computed tomography (CT) showed that venous drainage to the left renal vein was narrow, and the main venous drainage occurred through the inferior phrenic veins (Figure 1). Therefore, partial splenic artery embolization (PSE) was first performed to decrease portal vein pressure, and approximately 70% of the splenic area was embolized. However, further progression was observed after PSE. The approach with BRTO from the renal vein to the gastric varices and inferior phrenic veins was challenging; therefore, PTO was performed using a 6-Fr guiding sheath (Destination, Terumo Corporation) and 0.035 Radifocus Guidewire M (Terumo Corporation). Table 1 shows the pre-PTO blood test results, and the patient had

a Child-Pugh status A. The blood supply comprised a 10-mm left gastric vein and 4-mm right gastric vein. The left gastric vein was embolized with a 10-mm IMPEDE embolization plug through the 6-Fr guiding sheath (Figure 2D, black arrows), and the right gastric vein with three 60-cm packing coils (POD SYSTEM, Medico's HIRATA) through a 4-Fr COBRA type catheter (Hanaco Medical, Saitama) (Figure 2D, black arrowheads). The tip of the IMPEDE embolization plug was used to place the guide-wire against the plug and only the guiding sheath was pulled so that the plug was left in place. Approximately 10 min after deployment of the plug, plug expansion was confirmed using contrast injection.

However, contrast-enhanced CT showed no reduction in gastric varices after PTO, and we decided to perform BRTO with EO. Access for injecting contrast to the portal vein was obtained from the superior mesenteric artery. The contrast passed through the IMPEDE embolic plug in the left gastric vein and entered the gastric varices, confirming that embolization of the left gastric vein was not obtained. In BRTO, the approach from the left renal vein to the gastric varices was still not possible because of drainage vein stenosis. When contrast was administered from the origin of the left renal vein toward the drainage vein, it leaked into the inferior phrenic vein before the entire gastric varices could be visualized (Hirota's classification grade 3);

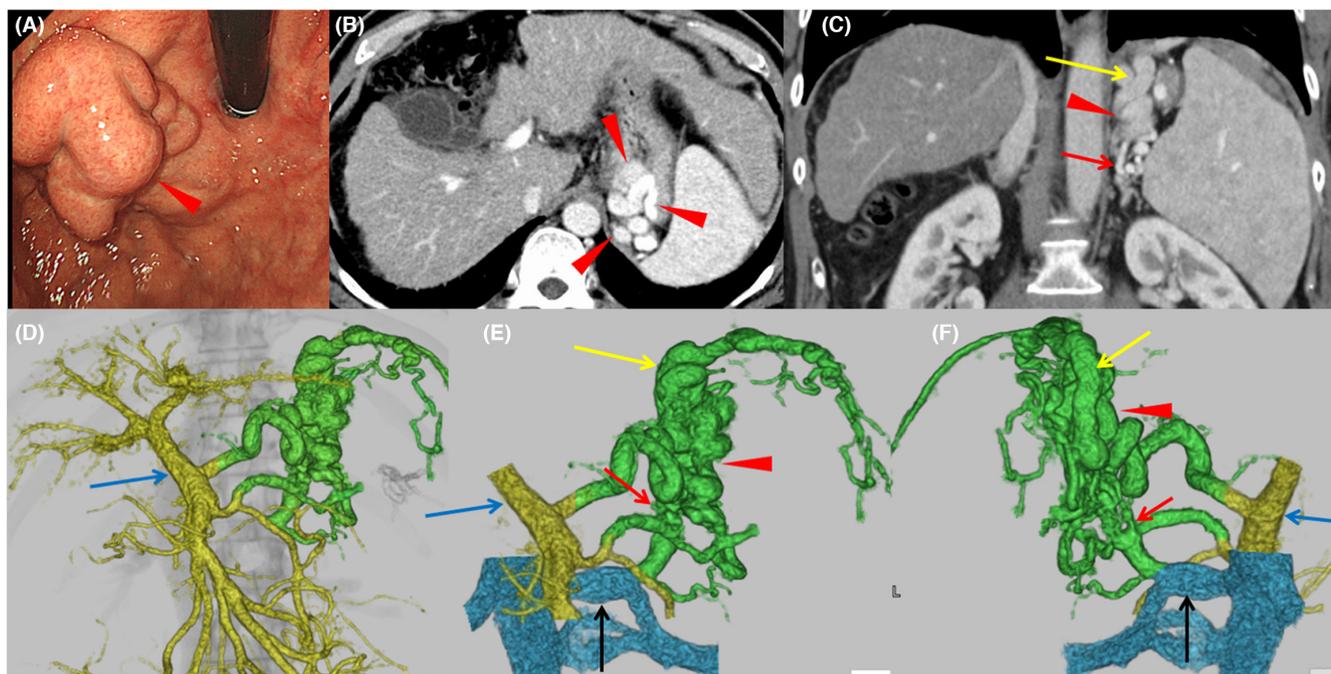


FIGURE 1 Pretreatment examination images. (A) Gastric endoscopy. (B) Contrast-enhanced computed tomography (CT) (axial view). (C) Contrast-enhanced computed tomography (coronal view). (D) Overall view. (E) Ventral view. (F) Dorsal view. Red arrowheads represent gastric varices. Red arrow indicates the narrow venous drainage of the renal vein. Yellow arrow indicates the inferior phrenic vein. Blue arrow indicates the portal vein. Black arrow indicates the left renal vein. CT, computed tomography.

TABLE 1 Pre-PTO laboratory parameters.

Parameter	Value	Units
WBC	4200	/ μ L
Hb	14.1	g/dL
Hct	39.9	%
MCV	98.5	fl
PLT	10.2	$\times 10^4$ / μ L
PT-INR	1.18	
PT%	74.4	%
T-BIL	1.4	mg/dL
AST	64	U/L
ALT	52	U/L
γ GTP	168	U/L
ALP	103	U/L
TP	7.0	g/dL
ALB	3.7	g/dL
HbA1c	6.1	%
BUN	9.0	mg/dL
CRE	0.76	mg/dL
CRP	0.091	mg/dL
AFP	4.8	ng/mL
PIVKA-II	14	mAU/mL
HBs antigens	(-)	
HBc antibody	(-)	
HCV antibody	(-)	

Abbreviations: AFP, alpha-fetoprotein; Alb, albumin; ALP, alkaline phosphatase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; Cr, creatinine; CRP, C-reactive protein; Hb, hemoglobin; HBc, antibody hepatitis B core antibody; HBs, antigen hepatitis B surface antigen; Hct, hematocrit; HCV, antibody hepatitis C virus antibody; PIVKA, protein induced by vitamin K antagonists; PLT, platelet count; PT, prothrombin time; PT-INR, International normalized ratio of prothrombin time; PTO, percutaneous transhepatic obliteration; T-BIL, total bilirubin; TP, total protein; WBC, white blood cells.

therefore, EO could not be administered into all gastric varices with BRTO. CT showed no reduction in gastric varices after BRTO (Figure 3). Finally, NBCA was injected endoscopically into the gastric varices for occlusion.

3 | DISCUSSION

BRTO and PTO procedures have limitations, such as unpredictable straying of the embolic material, resumption of blood flow, relatively long procedure time, and difficulty in determining efficacy because of post-procedure artifacts. IMPEDE embolization plug mounted to an anchor coil has been indicated to be potentially advantageous in

these aspects.⁶ However, the embolization with IMPEDE cannot be confirmed on site because the complete process takes several days.

The reasons for the failure of the IMPEDE embolization plug to occlude the feeder may be due to the fact that the plug may have been the exact size or undersized for the vein. Alternatively, the plug tends to embolize proximal to the feeder, which may leave gastric variceal blood flow if a collateral vein of gastric varices is present on the peripheral side. Jessen et al.⁶ reported that of the 18 arteries treated with IMPEDE, only one vessel (5.6%) showed 50%–75% occlusion and was less likely to produce a sustained therapeutic ischemic effect. In our case, the selection of an exact plug size for a vein which is more extensible than an artery was thought to be the reason for unsuccessful complete embolization of the left gastric vein.

Landsman et al.³ reported that the radial force of the expanded SMP is low; therefore, inserting a 12-mm diameter device in a 5- to 6-mm-sized vessel did not cause significant concern, and no significant distension of the vein around the implants was observed. SMP foams exert a radial force on the vessel wall, which is significantly smaller than that required for vessel rupture. This is also because foams are oversized by 50% of the inner diameter of the vessel, which is a common sizing practice when selecting an appropriately sized vascular plug.^{7,8} Therefore, we propose choosing a device diameter of up to 50% larger than the vein diameter to prevent embolic insufficiency and recanalization. In our case, we considered reinserting an IMPEDE of larger size into the left gastric vein. However, we determined that not enough length was available in the left gastric vein to place an additional IMPEDE, so we opted for BRTO and endoscopic therapy as the next best treatment option.

Adverse events associated with this material have been reported to be few and are commonly encountered when embolizing peripheral vasculatures with any embolic device. Moreover, they are unrelated to the use of this specific device.⁵

4 | CONCLUSION

IMPEDE embolization plug has been indicated to be potentially advantageous in several respects compared to NBCA or coils. However, embolization with IMPEDE cannot be confirmed on site. Therefore, we propose that the diameter of the device selected be up to 50% larger than the vein diameter to prevent embolization failure and recanalization. This is the first report on its use in PTO/BRTO of gastric varices.

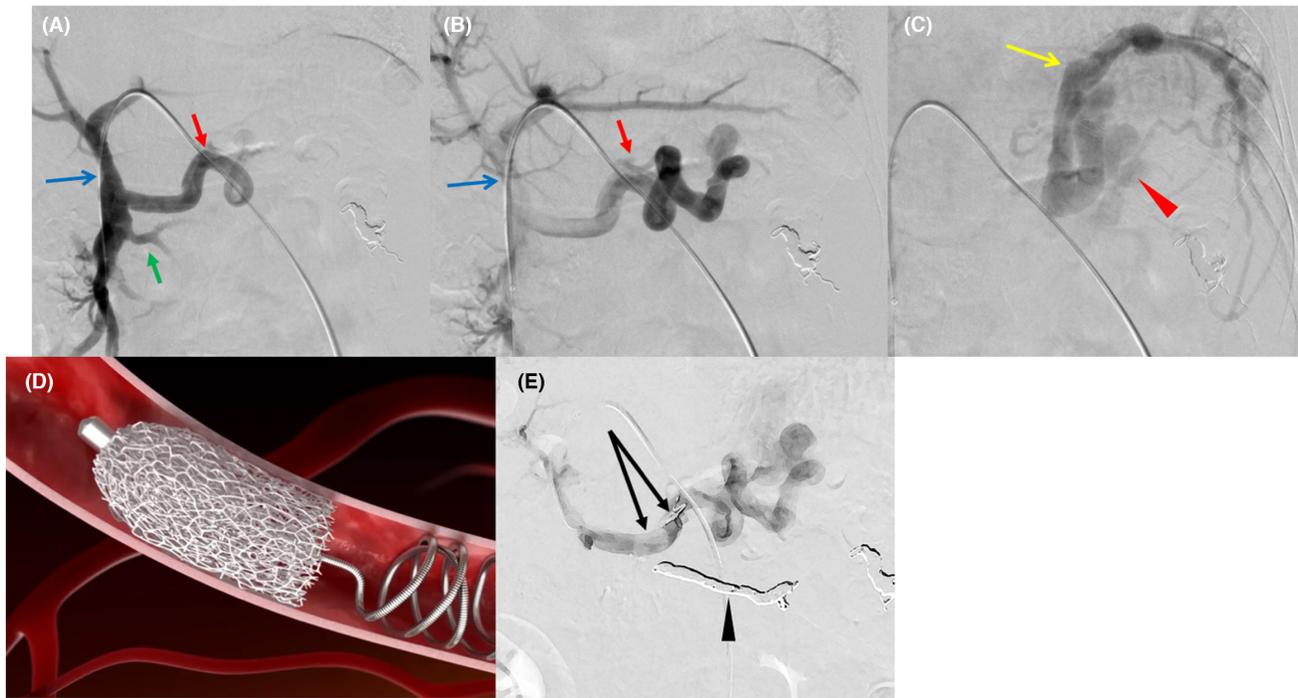


FIGURE 2 Percutaneous transhepatic obliteration (PTO). (A) Imaging of the left and right gastric veins through PTO. (B) The left gastric vein is mainly imaged using PTO. (C) Imaging of the inferior phrenic vein and gastric varices using PTO. (D) Illustration of IMPEDE embolization plug. (E) IMPEDE embolization plug in the left gastric vein and packing coils in the right gastric vein. Blue arrow indicates portal vein. Red arrow indicates a 10-mm left gastric vein. Green arrow indicates a 4-mm right gastric vein. Red arrowhead indicates gastric varices. Yellow arrow indicates the inferior phrenic vein. Black arrow indicates IMPEDE embolization plug. Black arrowhead indicates packing coils. PTO, percutaneous transhepatic obliteration.

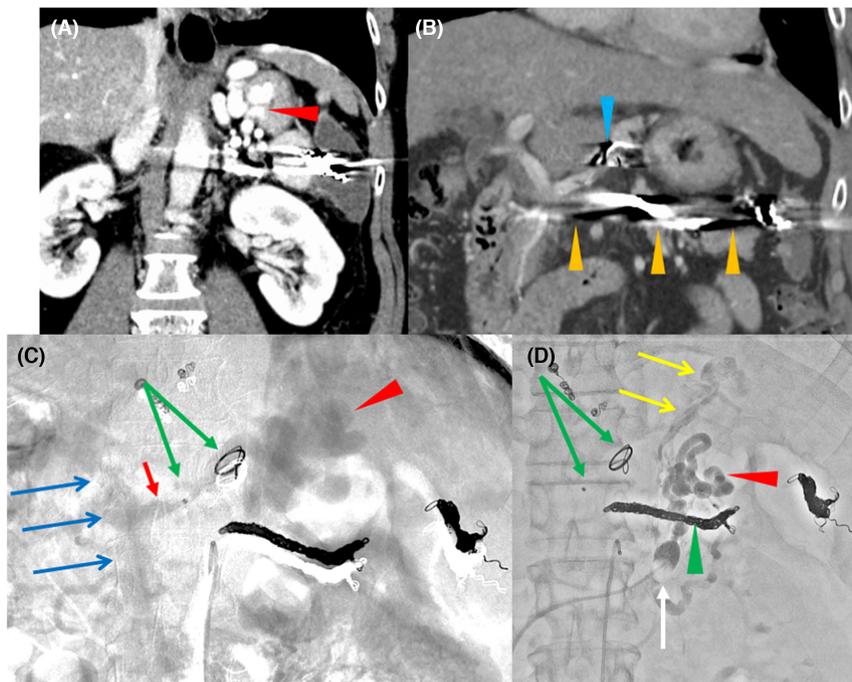


FIGURE 3 Images before and during balloon-occluded retrograde transvenous obliteration (BRTO). (A) Contrast-enhanced computed tomography (CT) before BRTO. (B) CT of IMPEDE embolization plug and coils artifact side by side. (C) Portal angiography image of the superior mesenteric artery. (D) Contrast injection into gastric varices during BRTO. Red arrowhead indicates gastric varices. Blue arrowhead indicates an artifact of IMPEDE embolization plug. Orange arrowheads indicate an artifact of packing coils. Blue arrow indicates the portal vein. Red arrow indicates the left gastric vein. Green arrow indicates IMPEDE embolization plug. Yellow arrow indicates the inferior phrenic vein. Green arrowhead indicates packing coils. White arrow indicates balloon catheter. BRTO, balloon-occluded retrograde transvenous obliteration; CT, computed tomography.

AUTHOR CONTRIBUTIONS

Sakue Masuda: Conceptualization; formal analysis; investigation; methodology; project administration; software; supervision; validation; visualization; writing – original draft; writing – review and editing. **Toshitaka Tsukiyama:** Supervision; validation; visualization; writing – review and editing. **Makomo Makazu:** Visualization; writing – review and editing. **Ryuhei Jinushi:** Software; writing – review and editing. **Kazuya Koizumi:** Writing – review and editing. **Takashi Nishino:** Investigation. **Kento Shionoya:** Investigation; visualization. **Karen Kimura:** Visualization. **Chihiro Sumida:** Visualization; writing – review and editing. **Jun Kubota:** Investigation. **Chikamasa Ichita:** Writing – review and editing. **Akiko Sasaki:** Supervision. **Masahiro Kobayashi:** Conceptualization; project administration; supervision. **Makoto Kako:** Supervision. **Haruki Uojima:** Writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ETHICAL APPROVAL

All procedures were performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

CONSENT

Informed written consent was obtained from the patient for the publication of this report and any accompanying images.

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