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Case Report

Coil-assisted retrograde transvenous obliteration of gastric varices by an inverted catheter tip technique via the pericardiophrenic vein [☆]

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ARTICLE INFO

Article history:

Received 24 September 2022

Revised 30 September 2022

Accepted 3 October 2022

Keywords:

Gastric varices

BRTO

CARTO

Transvenous obliteration

Portal hypertension

ABSTRACT

A 70-year-old woman with liver cirrhosis was admitted to our hospital for treatment of growing gastric varices in the fundus. Computed tomography showed gastric varices continuously draining the pericardiophrenic vein via the inferior phrenic vein. Balloon-occluded retrograde transvenous obliteration by a transjugular approach was planned. However, a conventional balloon catheter or microballoon catheter could not be inserted into the efferent vein near the varices because of the narrowness and tortuosity of the vein. Hence, coil-assisted retrograde transvenous obliteration was performed by an inverted catheter tip technique using a single conventional microcatheter. This technique might be useful for cases in which it is difficult to insert a balloon catheter into the efferent vein.

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[☆] Competing Interests: The authors declare that they have no conflict of interest.

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<https://doi.org/10.1016/j.radcr.2022.10.003>

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Introduction

Bleeding from gastric varices (GV) can be life-threatening. Balloon-occluded retrograde transvenous obliteration (BRTO) is one of the treatments for GV. The main efferent veins in cases of GV are gastrosplenic shunts, gastrocaval shunts, and pericardiophrenic veins (PCV). Among them, gastrosplenic shunts are the most common, occurring in 85% of patients with isolated GV (IGV) [1], and treatment via other efferent veins has only rarely been reported. BRTO from the PCV is often performed via the internal jugular vein [2]. However, in such cases, it is sometimes difficult to insert the catheter close to the GV because of the narrowness and tortuosity of the vein. We report a case of coil-assisted retrograde transvenous obliteration (CARTO) by an inverted catheter tip technique using a single conventional microcatheter in a patient with GV, without using a balloon catheter.

Case report

A 70-year-old woman who was under regular treatment at our hospital for cirrhosis and hepatocellular carcinoma due to nonalcoholic steatohepatitis had developed IGV. Laboratory tests on admission revealed blood levels of albumin of 3.9 g/dL (ref: 4.1–5.1 g/dL), bilirubin of 2.0 mg/dL (0.4–1.5 mg/dL), creatinine of 0.74 mg/dL (0.46–0.79 mg/dL), sodium of 140 mmol/L (138–145 mmol/L), prothrombin time of 69.6 % (70–130%), hemoglobin of 9.0 g/dL (11.6–14.8 g/dL), and platelet count of 69,000 / μ L (15,800–34,800 / μ L). Her Child-Pugh score was 7 (class B) and her Model for End-stage Liver Disease (MELD) score was 11. Upper gastrointestinal endoscopy showed IGV in

the fundus and thin esophageal varices. The IGV were beaded and moderately enlarged, with no red spots. Computed tomography (CT) showed a thin PCV via the inferior phrenic vein (IPV) as the main efferent vein. The varices were mainly fed by the posterior gastric vein, and the dilated left gastric vein joined in the drainage route of the varices (Fig. 1). There was no development of a gastrosplenic shunt in continuity with the varices. BRTO via the PCV was selected for treatment of the varices.

The left internal jugular vein was punctured with a 20-gauge needle under ultrasound guidance, and a 5F sheath (SuperSheath; Medikit Co. Ltd., Tokyo, Japan) and a 0.035" wire (Radifocus Guide Wire M; Terumo, Tokyo, Japan) were inserted into the selected PCV. A 5.2F balloon catheter (Selecon MP catheter II; Terumo) was inserted up to the level of the diaphragm. Balloon-occluded retrograde transvenous venography did not show the varices, although it showed drainage via the gastrocaval shunt and intercostal veins (Hirota Grade 4, Fig. 2) [3]. At the subdiaphragmatic level, the route to the varices was quite tortuous. A 1.9F micro balloon catheter (LOGOS GrandMaster; PIOLAX Medical Devices, Yokohama, Japan) could not reach the efferent vein near the varices. Only a 1.7F microcatheter (Progreat λ 17; Terumo) was able to advance the catheter closer to the varices. Therefore, CARTO with the inverted catheter tip technique was performed, as described below (Fig. 3a). Venography from the IPV did not show the afferent veins or varices (Fig. 3b). First, the microwire was inverted using the arcuate edge of the IPV and followed by the microcatheter (Fig. 3c). Next, a fiberoptic coil (Tornado18; Cook Medical, Bloomington, IN) was placed from the inverted microcatheter in the IPV (Figs. 3a–i). Then, the loop of the microcatheter was released (Fig. 3d). Venography showed that the left gastric vein was the afferent vein joining the drainage route of the varices, although it did not show varices (Fig. 3e). Then, the left gas-

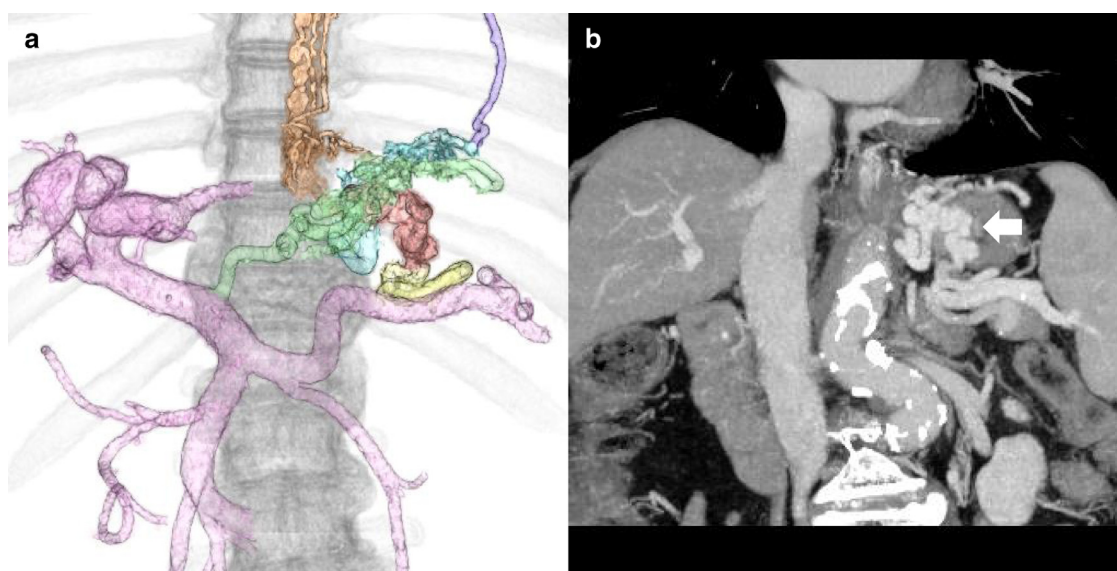


Fig. 1 – (a) Contrast-enhanced 3D computed tomography (CT) showing gastric varices (red color), esophageal varices (orange), the left gastric vein (green), posterior gastric vein (yellow), an intraphrenic vein shunt (light blue), and the pericardiophrenic vein (purple). (b) Maximum intensity projection image of portal-phase contrast-enhanced CT demonstrating gastric varices in the fundus (arrow).



Fig. 2 – Balloon-occluded retrograde transvenous venography from the pericardiophrenic vein (white arrowhead) did not show the varices, although it showed drainage via the gastrocaaval shunt (black arrowhead) and intercostal veins (white arrow) (Hirota Grade 4).

tric vein was embolized with a coil (Target XL; Stryker Neurovascular, Kalamazoo, MI; Fig. 3a-ii). And 5% ethanolamine oleate iopamidol was injected near the varices (Figs. 3a-iii and f). Cone-beam CT showed stagnation of the sclerosing agent in the IGV. On the third postoperative day, abdominal contrast-enhanced CT showed thrombosis of the IGV. At 2 months after BRTO, endoscopy showed shrinkage of the GV. The esophageal varices remained unchanged and will continue to be monitored.

Discussion

BRTO is widely used in East Asia and has been reported to have a good prognosis. The success rate of BRTO is 77–100% for acute GV, with a low rebleeding rate of 0–14% [4]. However, BRTO requires balloon occlusion of the main efferent vein, making it unsuitable for cases with long and tortuous efferent veins.

Several modified BRTO procedures have been developed to reduce complications and address technical issues and problems with certain types of sclerosants [5–8]. Plug-assisted retrograde transvenous obliteration was previously reported [5]. However, since plug-assisted retrograde transvenous obliteration is reported to be associated with more recurrence of GV than BRTO during long-term follow-up, its efficacy is controversial [9]. In addition, depending on the angulation and orientation of the efferent vein, it might be difficult to advance the long sheath within the vein for plug deployment [10]. Subsequently, Lee et al. [6] reported CARTO using coils instead of bal-

loon catheters. Although this method can be performed in all types of efferent veins, it requires a 2 catheter system to embolize the efferent vein with coils and inject the sclerosants. Although the CARTO-II has also been reported, it requires balloon occlusion similar to BRTO [7].

We adopted an inverted technique, which involves the inversion of a conventional microcatheter tip in the efferent vein. This can be accomplished via a single access route with only one conventional microcatheter and enables the injection of sclerosants from the microcatheter advanced into the vein near the varices without interference by coils. CARTO using the inverted technique in the efferent vein by a steerable microcatheter has been reported [8]. However, this requires a special device. Additionally, a steerable microcatheter might have slightly poorer trackability than a conventional microcatheter. Enlarged beaded vessels, such as the efferent vein, have arcuate edges that allow the wire or catheter to be easily reversed without using the steering catheter. Even in complicated cases where the route is too long, narrow, or complex to allow insertion of a balloon catheter, multiple microcatheters or a steerable microcatheter, retrograde transvenous obliteration can be performed by inserting a single microcatheter.

Conclusion

CARTO with the inverted catheter tip technique might be feasible in cases with technical difficulty in inserting a balloon catheter.

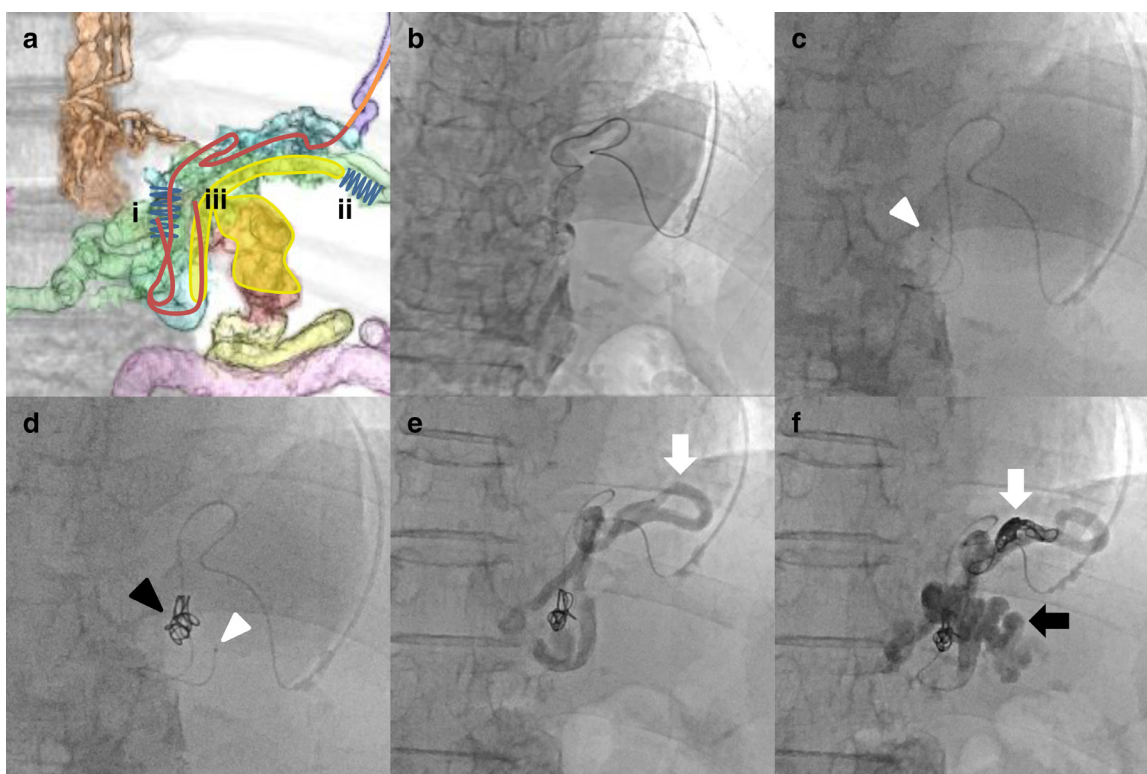


Fig. 3 – Embolization method. (a) The schema of coil-assisted retrograde transvenous obliteration with the inverted catheter tip technique showing the catheter (orange color), microcatheter (red), coils (blue), and ethanolamine oleate iopamidol (EOI; yellow). i: The inverted tip of the microcatheter and the first coil in the inferior phrenic vein (IPV). ii: The second coil in the left gastric vein. iii: EOI injected from the released microcatheter tip. (b) Venography without balloon occlusion from the IPV did not show the afferent veins or varices. (c) The inverted microcatheter tip was placed in the IPV (white arrowhead). (d) Coil embolization was performed from the inverted catheter tip (black arrowhead) and the loop of the microcatheter was released (white arrowhead). (e) Venography after coil embolization showed the left gastric vein as the afferent vein (white arrow), although it did not show varices. (f) Following coil embolization of the left gastric vein (white arrow), 10 mL of 5% EOI was injected, which enabled visualization of the varices (black arrow).

Patient consent

Written informed consent for publication of this case was obtained from the patient.

REFERENCES

- [1] Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Correlation between endoscopic and angiographic findings in patients with esophageal and isolated gastric varices. *Dig Surg* 2001;18(3):176–81.
- [2] Kageyama K, Nishida N, Matsui H, Yamamoto A, Nakamura K, Miki Y. Successful balloon-occluded retrograde transvenous obliteration for gastric varix mainly draining into the pericardiophrenic vein. *Cardiovasc Intervent Radiol* 2012;35(1):180–3.
- [3] Hirota S, Matsumoto S, Tomita M, Sako M, Kono M. Retrograde transvenous obliteration of gastric varices. *Radiology* 1999;211(2):349–56.
- [4] Patel A, Fischman AM, Saad WE. Balloon-occluded retrograde transvenous obliteration of gastric varices. *AJR Am J Roentgenol* 2012;199(4):721–9.
- [5] Gwon DI, Ko GY, Yoon HK, Sung KB, Kim JH, Shin JH, et al. Gastric varices and hepatic encephalopathy: treatment with vascular plug and gelatin sponge-assisted retrograde transvenous obliteration—a primary report. *Radiology* 2013;268(1):281–7.
- [6] Lee EW, Saab S, Gomes AS, Busuttill R, McWilliams J, Durazo F, et al. Coil-assisted retrograde transvenous obliteration (CARTO) for the treatment of portal hypertensive variceal bleeding: preliminary results. *Clin Transl Gastroenterol* 2014;5(10):e61.
- [7] Yamamoto A, Jogo A, Kageyama K, Sohgwawa E, Hamamoto S, Hamuro M, et al. Utility of coil-assisted retrograde transvenous obliteration II (CARTO-II) for the treatment of gastric varices. *Cardiovasc Intervent Radiol* 2020;43(4):565–71.
- [8] Terada K, Ogi T, Yoneda N, Yokka A, Sugiura T, Koda W, et al. Coil-assisted retrograde transvenous obliteration (CARTO) for the treatment of gastric varices via a single access route using steerable microcatheter: a case report. *CVIR Endovasc* 2020;3(1):30.
- [9] Kim YH, Kim YH, Kim CS, Kang UR, Kim SH, Kim JH. Comparison of balloon-occluded retrograde transvenous

obliteration (BRTO) using ethanolamine oleate (EO), BRTO using sodium tetradecyl sulfate (STS) foam and vascular plug-assisted retrograde transvenous obliteration (PARTO). *Cardiovasc Intervent Radiol* 2016;39(6):840–6.

[10] Mukund A, Anandpara KM, Ramalingam R, Choudhury A, Sarin SK. Plug-assisted retrograde transvenous obliteration (PARTO): anatomical factors determining procedure outcome. *Cardiovasc Intervent Radiol* 2020;43(10):1548–56.