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TECHNICAL NOTE

Successful Balloon-Occluded Retrograde Transvenous Obliteration for Gastric Varix Mainly Draining into the Pericardiophrenic Vein

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Abstract Two cases of gastric varices were treated by balloon-occluded retrograde transvenous obliteration via the pericardiophrenic vein at our hospital, and both were successful. One case developed left hydrothorax. Gastric varices did not bled and esophageal varices were not aggravated in both cases for 24–30 months thereafter. These outcomes indicate the feasibility of balloon-occluded retrograde transvenous obliteration via the pericardiophrenic vein.

Keywords Gastric varix · Balloon-occluded retrograde transvenous obliteration · Pericardiophrenic vein

Introduction

Balloon-occluded retrograde transvenous obliteration (B-RTO) is an established method of treating solitary gastric varices with a gastrorenal shunt (GR shunt) in Japan and elsewhere [1–3]. However, patients with a gastric varix sometimes have multiple draining veins in addition to a GR shunt, and anatomical knowledge of these veins is critically important for treatment [4–6] (Fig. 1). A GR shunt serves as the main drainage route for 80–85% of gastric varices, and the inferior phrenic, intercostal, or pericardiophrenic (PCV) vein can function as accessory draining veins [5–8]. The inferior phrenic vein serves as the main drainage route for 10–15% of all gastric varices, whereas the PCV is thought rarely to fulfill this function [4, 6, 9, 10]. Even when the PCV is the main draining vein, B-RTO should be performed via this route to prevent rupture of a gastric varix.

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Patients and Methods

The institutional review board of our institution approved these case reports. The B-RTO procedure via the PCV was performed in two male patients. The case 1 patient had gastric varix and liver cirrhosis caused by hepatitis C virus infection, and the case 2 patient had idiopathic liver cirrhosis. Both of them had enlarged, tortuous gastric varices in the gastric fornix and cardia that were in danger of rupture at endoscopy. Routine contrast medium-enhanced computed tomography (CT) revealed that the main draining vein was the PCV in both patients (Figs. 2A–D, 3A–B). The case 1 patient has the other main draining vein, such as GR shunt (Fig. 2D).

Technical Description

The B-RTO procedure was essentially the same as conventional B-RTO with a GR shunt. A 5-Fr balloon catheter with a 10-mm balloon (MOIYAN, Miyano, Osaka, Japan) was advanced into the PCV from the right femoral vein under local anesthesia. Balloon-occluded retrograde transvenous venography (B-RTV) was performed. If collateral draining veins were visualized by B-RTV, we chose one of three techniques, such as to embolize collateral draining veins with microcoils, to use the microballoon catheter additionally, and to perform dual B-RTO [11, 12]. When B-RTV showed contrast medium retention in the gastric varix, a sclerosing agent was injected stepwise into the varix from the balloon catheter [8]. The sclerosing agent

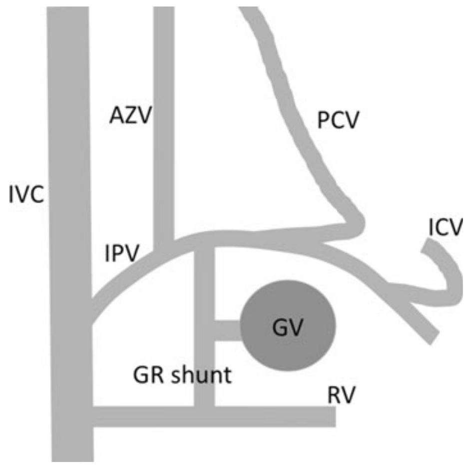

Fig. 1 Schematic representation of draining veins. *AZV* azygos vein, *GR shunt* gastrorenal shunt, *GV* gastric varix, *ICV* intercostal vein, *IPV* inferior phrenic vein, *IVC* inferior vena cava, *PCV* pericardiophrenic vein, *RV* renal vein

(5% EOI) comprised equal volumes of 10% ethanolamine oleate (Oldamin, Takeda Pharmaceutical, Osaka, Japan) and 350 mg of the nonionic contrast medium iopamidol. If a large volume of the sclerosing agent was required, then 50% glucose was additionally used instead of 5% EOI. Before 5% EOI injection, 4,000 units of human haptoglobin (Mitsubishi Tanabe Pharma, Osaka, Japan) were administered intravenously to prevent EOI-induced hemolysis and subsequent renal failure.

Results

Case 1

A 5-Fr balloon catheter was advanced into the GR shunt, and B-RTV was performed. The PCV and inferior phrenic vein were depicted (Fig. 2E). We planed to embolize collateral draining veins with microcoils. However, the GR shunt was too tortuous to forward the microcatheter to the inferior phrenic vein. So, dual B-RTO was selected to treat a varix. The other 5-Fr balloon catheter was advanced into the PCV (Fig. 2E), but that in the PCV could not reach the vicinity of the varix. Balloon catheter was inflated at the midpoint of the PCV within the mediastinum. We injected 13 ml of 50% glucose from the PCV and 10 ml from the GR shunt followed by 30 ml of 5% EOI from the PCV and 27 ml from the GR shunt. The obliteration was completed and successful. The postoperative complication of a left hydrothorax was developed and spontaneously subsided 10 days later. The varix did not recur or bleed for 24 months.

Case 2

A 5-Fr balloon catheter was advanced to the midpoint of the PCV within the mediastinum (Fig. 3C). However, it could not be forwarded beyond the diaphragm. Then, microballoon catheter (4.8-mm balloon; Attendant balloon catheter, Terumo Clinical Supply, Gifu, Japan) was

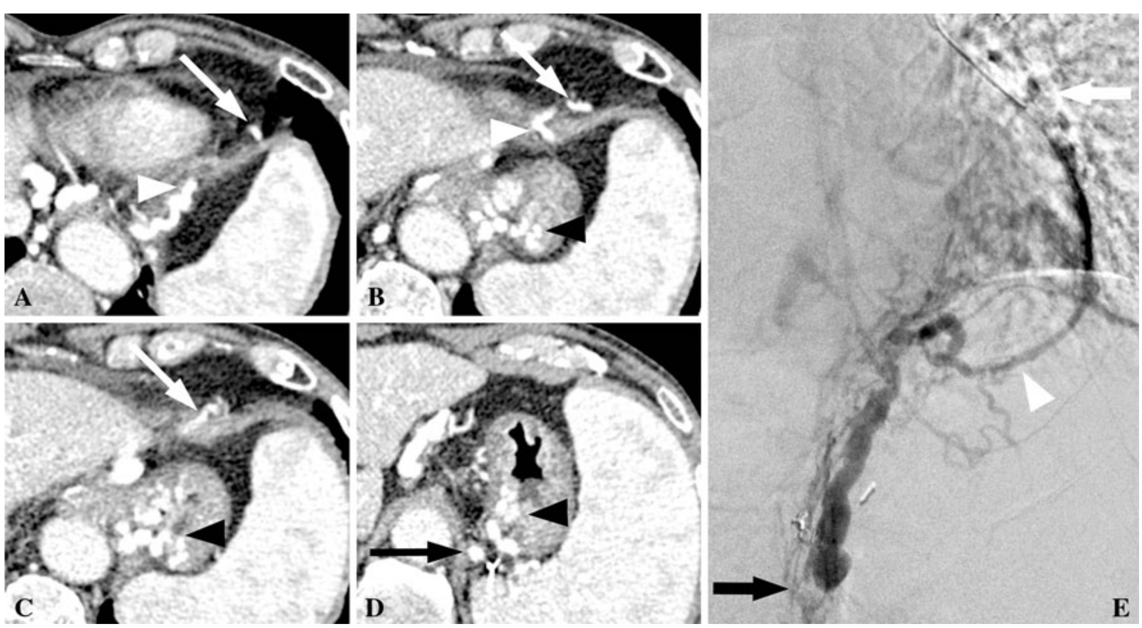

Fig. 2 Case 1. **A**–**D** Contrast medium-enhanced CT detected that two main draining veins were the pericardiophrenic vein (*white arrow*) and GR shunt (*black arrow*). The pericardiophrenic vein connected with inferior phrenic vein (*white arrowhead*) and gastric varix (*black arrowhead*). **E** Balloon-occluded retrograde transvenous venography from GR shunt (*black arrow*) depicts pericardiophrenic vein (*white arrow*) and inferior phrenic vein (*white arrowhead*)

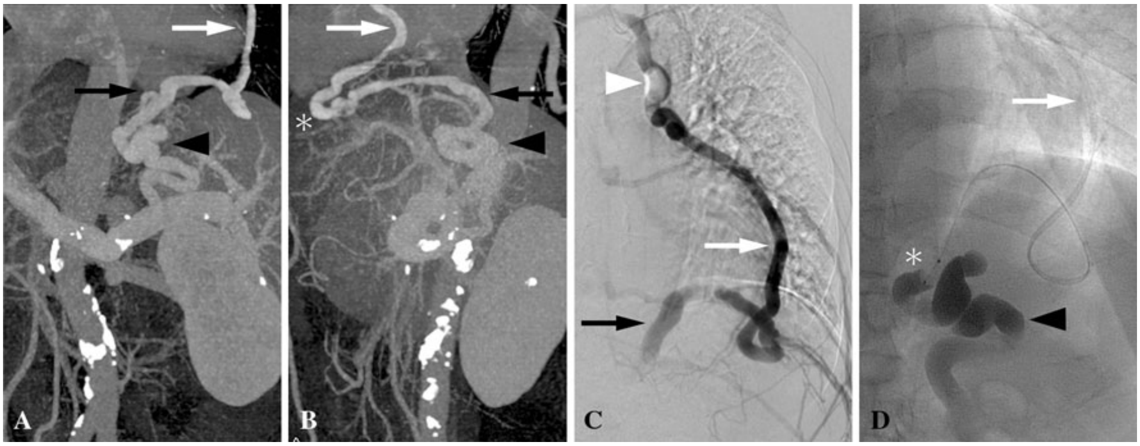

Fig. 3 Case 2. **A** and **B** Maximum intensity projection images. The image of **A** was projected from an *anterior view* position and **B** was projected from a *left lateral view* position. These images depicted gastric varix (*black arrowhead*) connecting to inferior phrenic vein (*black arrow*) and pericardiophrenic vein (*white arrow*). *Left lateral view* of **B** revealed that the pericardiophrenic vein forms a steep angle at the junction of the inferior phrenic vein (*). **C** Balloon-occluded retrograde transvenous venography from pericardiophrenic vein (*white arrow*) shows inferior phrenic vein (*black arrow*). The tip of the 5-Fr balloon catheter is located at white arrowhead. **D** Microballoon catheter (*white arrow*) is advanced smoothly beyond diaphragm into draining vein near varix (*black arrowhead*). The tip of the microballoon catheter is located at *asterisk* (*)

inserted from the left jugular vein into the PCV and smoothly advanced beyond the diaphragm, and B-RTO was performed with 7 ml of 5% EOI in the vicinity of the varix (Fig. 3D). The varix was obliterated without postoperative complications. The varix did not recur or bleed for 30 months.

Discussion

It has been reported that B-RTO via the PCV is a feasible procedure [9, 10]. We reported two patients who underwent B-RTO via the PCV, and the procedure was successful for both. Although B-RTO is more challenging via the PCV than the GR shunt, it is feasible for treating gastric varices and prevents rupture. The recurrence rates of gastric varix are lower after B-RTO without a GR shunt than those of percutaneous transhepatic obliteration or endoscopic injection [13]. If CT reveals PCV as a main draining vein, then B-RTO should be applied via this vein.

When performing B-RTO via the PCV, the following anatomical features are important to understand. The PCV has a longer length and narrower diameter than inferior phrenic vein or GR shunt [9]. It courses from the left brachiocephalic vein to the level of the intersection with the diaphragm. It joins several veins, including draining veins, such as the intercostal or left inferior phrenic vein at the intersection with the diaphragm (Fig. 3C). It forms a particularly sharp angle at the junction of the inferior phrenic vein [9] (Fig. 3B).

The key to the technical success of B-RTO via the PCV is to advance the catheter beyond the diaphragm to a location near the varix. Left hydrothorax developed in one patient in whom B-RTO was performed with a 5-Fr catheter at the mediastinal region, and this patient required a large volume of sclerosing agent because of anastomoses with several draining veins. Araki et al. [9] and Yoshimatsu et al. [10] reported successful BRTO via the PCV at the level of the diaphragm or the vicinity of the gastric varix. No postoperative left hydrothorax was developed. To our knowledge, left hydrothorax after B-RTO via the PCV has

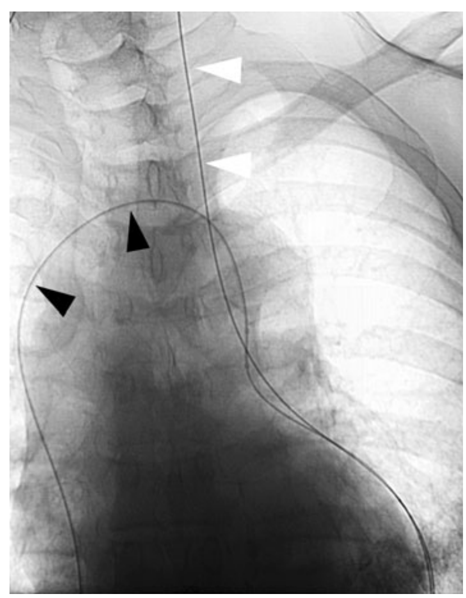

Fig. 4 Case 2. A microballoon catheter from left jugular vein (*white arrowheads*) allows effective advancement straight into pericardiophrenic vein. *Black arrowheads* indicate a 5-Fr balloon catheter from femoral vein

not been reported. We speculate that left hydrothorax arises due to B-RTO at the mediastinal region causing pleural inflammation and retention within the thoracic vein. In case 2, we applied two technical modifications. First, a micro-balloon catheter was advanced beyond the diaphragm and easily forwarded into the curved regions of the vessels. Second, changing the puncture site to the left jugular vein, which lies opposite the PCV across the brachiocephalic vein, allowed a catheter to proceed straight from the left jugular vein to the PCV (Fig. 4). We conclude that B-RTO via the PCV is feasible for treating gastric varices.

Conflicts of interest The authors declare that they have no conflict of interest.

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