Case Report

Balloon-occluded retrograde transvenous obliteration successfully performed for a large gastric varix in combination with temporary occlusion of the splenic artery in a child

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Abstract

We encountered a 10-year-old boy with a gastric varix that occurred after long-term treatment by Kasai’s hepatic portoenterostomy for biliary atresia for which balloon-occluded retrograde transvenous obliteration (B-RTO) was performed. With the standard B-RTO procedure, sufficient distribution in the entire gastric varix could not be obtained. However, the gastric varix was successfully treated by the addition of occlusion of the splenic artery by inflation of a balloon catheter during B-RTO.

Keywords

Interventional radiology, portography, stomach, varices, veins, therapeutic blockade

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Gastric varices are a complication of portal hypertension (1,2), but are less common than esophageal varices (1). However, once gastric varices bleed the mortality rate without therapy is high, at 45–55% (1), making quick management necessary. Balloon-occluded retrograde transvenous obliteration (B-RTO) is considered an effective therapy for gastric varices (3,4).

The presence of a gastro-renal shunt has been reported in almost all, that is, 97%, of advanced gastric varices as a complication of portal hypertension (2). In the B-RTO procedure, the balloon catheter is usually inserted into the gastro-renal shunt from the inferior vena cava through the left renal vein to occlude the gastro-renal shunt after which sclerotic agents are injected into the gastric varix.

Recently, we experienced a 10-year-old boy with a gastric varix occurring after long-term treatment by Kasai’s hepatic portoenterostomy for biliary atresia with successful disappearance of jaundice. B-RTO was performed for this patient, but was not completely effective using the usual method employed. For this case, we finally succeeded by performing B-RTO while the splenic artery was transiently occluded with inflation of a balloon catheter.

Case report

Kasai’s hepatic portoenterostomy procedure for biliary atresia was performed for this infant at the age of 69 days. Follow-up endoscopy showed the presence of esophageal and gastric varices, with enlargement of the gastric varix evident by the age of 10 years. Endoscopic examination revealed a bead-shaped moderate varix

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without red color sign located at the gastric cardia and fornix. Contrast-enhanced multi-detector row computed tomography (CT) confirmed that the gastric varix drained into a large gastro-renal shunt. This patient was admitted for treatment of the large gastric varix for prevention of rupture.

We performed the following procedures under intravenous anesthesia with an interventional CT system that had a unified CT and angiography unit made by Toshiba Medical Systems (Aquilion LB combined with Infinix Celeve-i INFX-8000 V, Tokyo, Japan).

First, a 5-F catheter was inserted from the left femoral artery after which superior mesenteric arterial portography and splenic arterial portography were performed to identify the anatomic locations of the gastric varix and the portal venous system in this patient. CT obtained during superior mesenteric arteriography in the portal venous phase (CTAP) was additionally done. These images showed that the left gastric vein was an afferent vein of the gastric varix. Short gastric and posterior gastric veins were also afferent veins (Fig. 1a). The gastro-renal vein was the drainage vein for the gastric varix.

Then, B-RTO was performed according to the method described by Kanagawa et al. (3). After an 8-F catheter sheath introducer (Medikit, Tokyo, Japan) was inserted from the right femoral vein, a 6-F balloon catheter with a balloon 20mm in diameter (Selecon MP catheter, Terumo Clinical Supply, Gifu, Japan) was advanced to the gastro-renal shunt at the highest position possible through the sheath introducer. A micro-catheter (Renegade hi-flo, Boston Scientific, Watertown, MA, USA) was then coaxially advanced into the gastric varix. The balloon was inflated to occlude the gastro-renal shunt, and the sclerosing agents were injected slowly as a stepwise injection (5) from the micro-catheter. The sclerosing agents used were 50% glucose solution and 5% ethanolamine oleate-iopamidol (EOI) in which 10% ethanolamine oleate (Oldamin; Takeda Pharmaceutical, Osaka, Japan) and the same volume of a non-ionic contrast medium (370 mg of iodine, Iopamiron, Bayer, Osaka, Japan) were mixed. A total of 15 mL of the 5% EOI and 10 mL of the 50% glucose solution were administered by four manual injections over a 70-min period (Fig. 1b). However, distribution of sclerotic agents in the entire gastric varix was not obtained. Plain CT also showed distribution of sclerosing agents in most but not all of the gastric varix (Fig. 1c). We then inserted a 5-F balloon catheter with a balloon 9 mm in diameter (Selecon MP catheter, Terumo Clinical Supply) through the 5-F sheath introducer from the femoral artery for advancement into the splenic artery. The balloon in the splenic artery was inflated. Retrograde venography performed while contrast material was infused from the micro-catheter positioned in the gastric varix showed the entire gastric varix (Fig. 1d). Thus, 2 mL of 5% EOI was additionally administered from the microcatheter while the balloon in the splenic artery remained inflated. Then, sufficient distribution of the sclerosing agents in the entire gastric varix was confirmed on both fluoroscopy and plain CT (Fig. 1e). The balloon in the splenic artery was deflated after 15 min. The balloon in the gastro-renal shunt was kept completely inflated for 4h. Finally, the balloon in the gastro-renal shunt was slowly deflated under fluoroscopy while meticulous care was taken so that the sclerotic agents would not drain out to the renal vein. All catheters and sheath introducers were withdrawn.

During injection of EOI, human haptoglobin (4000 units) (Mitsubishi Tanabe Pharma, Osaka, Japan) was administered intravenously to prevent hemolysis and subsequent renal failure, which may be induced by ethanolamine oleate.

Complete disappearance of enhancement in the gastric varix was confirmed by a contrast-enhanced CT scan obtained 1 month after the procedure. There were no complications during the procedure. Hepatic function, renal function, and blood cell counts did not significantly change after the procedure. Currently, 6 months after the procedure, there has been no recurrence of the gastric varix.

**Discussion**

In 1984, Olson et al. (6) first reported a case of gastric varix treated with B-RTO using ethanol as the sclerotic agent; however, the treatment did not result in disappearance of the gastric varix. But since the preliminary report by Kanagawa et al. of the use of EOI as the sclerotic agent (3), reports of the effectiveness of B-RTO for gastric varices in adults have increased (4,5,7–9).

On the other hand, reports of B-RTO performed for a gastric varix in a child have been few (10). The youngest case reported in the literature was 2 years old (10). In all reported pediatric cases of B-RTO, the procedure was performed under general anesthesia, although B-RTO was successfully and safely performed only with intravenous anesthesia in the present case.

Ethanolamine oleate agglutinates platelets and destroys the endothelial cells of the vessels, then works as a sclerotic agent. However, this agent can occasionally be diverted to the destruction of red blood cell membranes (4). Thus, although few, there have been reports of complications caused by this sclerotic agent such as pulmonary edema, disseminated intravascular coagulation, hemothorax, cardiogenic shock, and renal tubular disturbance and renal insufficiency, all of which were
Fig. 1. A 10-year-old boy with gastric varices. (a) CT obtained during superior mesenteric arteriography in the portal venous phase shows the gastric varix (arrows). (b) Right anterior oblique view by roentgenogram obtained after infusion of the sclerotic agent from a microcatheter advanced into the gastric varix coaxially via a balloon catheter positioned at the gastro-renal shunt (arrowhead) shows distribution of the sclerotic agent in most but not all of the gastric varix (arrow). (c) CT obtained after infusion of the sclerotic agent from the microcatheter advanced into the gastric varix coaxially via a balloon catheter positioned at the gastro-renal shunt reveals lack of distribution in part of the varix (white arrow). (d) Right anterior oblique view by balloon-occluded retrograde venography after inflating the balloon in the splenic artery (arrowhead) showed that the remnant part of gastric varix was filled with contrast agents (arrow). (e) CT obtained after additional infusion of the sclerotic agent from the microcatheter advanced into the gastric varix coaxially via the balloon catheter positioned at the gastro-renal shunt while inflating the balloon in the splenic artery reveals distribution in the entire gastric varix (arrow).
attributable to hemolysis of red blood cells caused by ethanolamine oleate. In adult cases, it has been recommended that the volume of EOI used should be in the range of 20–30 mL (4,7) because of the possibility of the adverse effects described above.

When the volume of EOI is not sufficient for distribution in the entire gastric varix within the limits recommended, attempts have been reported to decrease the volume of 5% EOI such as occlusion of the gastro-renal shunt at the proximal site by advancement of a balloon catheter and selective injection of the sclerosing agent into gastric varices through a microcatheter (8). Another method reported is the addition of 50% glucose solution. Because the 50% glucose solution injected into the varix will replace red blood cells, EOI will attach to endothelial cells but not to red blood cells (4,7). As a result, the volume of EOI required decreased after infusion of the 50% glucose solution prior to EOI. In the present case, we applied these methods from the beginning considering the large size of the gastric varix for a child. However, the entire gastric varix was not obliterated even with the use of these strategies. Thus we additionally performed balloon occlusion of the splenic artery during B-RTO, which finally resulted in sufficient distribution of sclerosing agents in the entire gastric varix.

Temporary balloon occlusion of the splenic artery during B-RTO is a newly developed technique, and the favorable effects of this technique can be explained by a recent report of Yoshimatsu et al. (9), in which changes in hemodynamics after balloon occlusion of the splenic artery during B-RTO were evaluated in eight patients. In their study (9), balloon-occluded venous pressure of the drainage vein decreased after balloon occlusion of the splenic artery in 7/8 patients (88%), and the degree of reduction in pressure was statistically significant. Therefore, blood flow from the variceal complex decreased. In addition, on findings of balloon occluded retrograde venography the variceal complex was more extensively visualized after occlusion of the splenic artery with the same dose of contrast material as used without such occlusion in seven of the eight patients studied. This clarified that pressure in the posterior and short gastric veins decreased after balloon occlusion of the splenic artery. These results suggest that B-RTO assisted by temporary balloon occlusion of the splenic artery has the potential to change the flow direction, resulting in sufficient filling of gastric varices with afferent veins, and to decrease the blood flow in the varix, which might result in a reduction in the dose of the sclerosing agent.

In conclusion, B-RTO assisted by temporary balloon occlusion of the splenic artery for a large gastric varix was successfully performed in a child. In performing B-RTO for cases in which the dose of sclerosing agents is limited, as in pediatric cases, knowledge of such modified methods might be helpful.

**Conflict of interest**

None declared.

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