International Journal of Gastrointestinal Intervention

journal homepage: www.ijgii.org

Original Article

Balloon-occluded retrograde transvenous obliteration for six consecutive patients with duodenal varices

Shiro Miyayama^{1,*}, Masashi Yamashiro¹, Rie Ikeda¹, Junichi Matsumoto¹, Nobuhiko Ogawa¹, and Kazuo Notsumata²

A B S T R A C T

Background: Bleeding from duodenal varices is a rare but life-threatening complication of portal hypertension. The treatment of duodenal varices remains difficult and a definitive treatment strategy has not been established. The aim of this study was to report the technical aspects and outcomes of balloon-occluded retrograde transvenous obliteration (BRTO) using 5% ethanolamine oleate with iopamidol (EOI) for duodenal varices.

Methods: Six consecutive patients with duodenal varices treated using BRTO were eligible. Endoscopic treatment was performed first in three patients with active bleeding. After coil embolization of collateral veins, stepwise EOI infusion was performed at intervals of 10–30 minutes under balloon occlusion until the main efferent vein, varices, and the main afferent vein were filled with EOI and clots. The techniques and outcomes of BRTO were retrospectively evaluated.

Results: The main efferent vein of duodenal varices was the right ($n = 4$) or left ($n = 2$) gonadal vein. In three patients with ruptured varices, BRTO was performed after achieving hemostasis by endoscopic treatment. In five patients, 1–4 (mean, 2.4 ± 1.1) collateral veins were embolized with coils before EOI infusion. Furthermore, 11–21 mL (mean, 15.3 ± 4.2 mL) of EOI was infused by 3–5 (mean, 3.5 ± 1.0) stepwise infusions via the efferent vein under balloon occlusion. The duration of EOI infusion under balloon occlusion ranged from 82 to 118 minutes (mean, 87.8 ± 13.6 minutes). The varices were thrombosed in all but one patient. In the remaining patient, the varices were thrombosed by additional BRTO under overnight balloon occlusion performed 19 days later. The only complications were a transient fever and hematuria. All duodenal varices disappeared during a follow-up of 4–32 months (mean, 16.2 ± 11.1 months) after BRTO.

Conclusion: BRTO using EOI is an effective treatment for duodenal varices.

Copyright © 2022, Society of Gastrointestinal Intervention.

Keywords: Ethanolamine oleate; Radiology, interventional; Varicose veins

Introduction

Bleeding from duodenal varices is a rare but life-threatening complication of portal hypertension.^{1,2} The treatment of duodenal varices remains difficult, and a definitive treatment strategy has not been established despite the availability of several treatment options, such as surgical resection,² endoscopic treatment,^{3–5} and endovascular interventions.^{6–16} Endovascular interventions include percutaneous transhepatic obliteration (PTO),^{6–9} transjugular intrahepatic portosystemic shunt (TIPS),¹⁰ and balloon-occluded retrograde transvenous obliteration (BRTO).^{6–9,11–18} Of these options, BRTO is the first-line treatment option for duodenal varices

because no recurrent bleeding has been reported after successful treatment.^{8,11–18} However, duodenal varices are frequently difficult to treat through simple BRTO alone, and an additional procedure is frequently required.^{8,9,11–13}

We encountered six patients with duodenal varices, including three with active bleeding, and we attempted to treat all patients with BRTO using 5% ethanolamine oleate with iopamidol (EOI). Thus, the purpose of this study was to report the technical aspects and outcomes of BRTO for duodenal varices in six consecutive patients.

¹Department of Diagnostic Radiology, Fukui-Ken Saiseikai Hospital, Fukui, Japan²Department of Internal Medicine, Fukui-Ken Saiseikai Hospital, Fukui, Japan

Received May 7, 2021; Revised June 2, 2021; Accepted June 2, 2021

* Corresponding author. Department of Diagnostic Radiology, Fukui-Ken Saiseikai Hospital, 7-1, Funabashi, Wadanaka-cho, Fukui 918-8503, Japan.

E-mail address: s-miyayama@fukui.saiseikai.or.jp (S. Miyayama).

Methods

The institutional review board approved this retrospective analysis (approval No. 2021-002) and the requirement for individual patient consent was waived. Written informed consent was obtained from each patient before the BRTO procedure.

Patients

Between August 2001 and May 2020, six consecutive patients with ruptured ($n = 3$) or growing ($n = 3$) duodenal varices were treated with BRTO in our hospital (Table 1; Fig. 1, 2). There were four male and two female patients, with a mean age $\pm$ standard

deviation of 59.9 ± 11.4 years (range, 50–80 years). All patients had liver cirrhosis; in five cases, cirrhosis was related to alcohol ($n = 3$) or hepatitis C virus ($n = 2$), while the remaining case involved secondary biliary cirrhosis following hepaticojejunostomy for bile duct injury during cholecystectomy ($n = 1$). The diagnosis of duodenal varices was established by contrast-enhanced computed tomography (CT) (Fig. 2A) and endoscopy (Fig. 1A, 2B) in all six patients. The anatomical features of duodenal varices, such as their location and the orifice and size of the efferent and afferent veins, were also evaluated by CT. In the first two patients, abdominal angiography and CT during arterial portography were performed to evaluate the detailed anatomical features of the duodenal varices (Fig. 1B). In three patients with ruptured varices,

Table 1 Summary of Patient Backgrounds and Outcomes

Patient no./age (yr)/sex	Etiology of liver cirrhosis	Drainage route	Approach route	Endoscopic treatment	No. of collaterals embolized with coils	No. of EOI injections	Total dose of EOI (mL)	Duration of EOI injections (min)	Outcomes	Follow-up period (mo)
1/75/Female	SBC	RGV	RIJV	None	4	3	18	107	Not thrombosed [†]	32
2/67/Male	HCV	LGV	RIJV	None	1	3	12.5	103	Thrombosed	28
3/76/Male	Alcohol	RGV	RFV	None	2	3	10.5	105	Thrombosed	4
4/60/Male*	Alcohol	RGV	RFV	Clipping	2	5	11	86	Thrombosed	12
5/80/Male*	HCV	RGV	RFV	EVL	0	4	21	118	Thrombosed	11
6/50/Female*	Alcohol	LGV	RFV	EVL	3	3	19	82	Thrombosed	10

EOI, ethanolamine oleate with iopamidol; SBC, secondary biliary cirrhosis; HCV, hepatitis C virus; RGV, right gonadal vein; LGV, left gonadal vein; RIJV, right internal jugular vein; RFV, right femoral vein; EVL, endoscopic variceal ligation.

*The patient had ruptured varices.

[†]The varices were thrombosed by additional BRTO performed 19 days later.

Fig. 1. A 67-year-old male with duodenal varices. (A) Endoscopy showed large varices in the duodenum. (B) Computed tomography during arterial portography showed tortuous and dilated varices in the third portion of the duodenum (arrows). The afferent vein was the inferior pancreaticoduodenal vein (asterisk) and the efferent vein drained into the left gonadal vein (arrowhead). (C) On retrograde venography under balloon occlusion of the left gonadal vein, a collateral vein (an anastomosis with retroperitoneal veins) (asterisk) was demonstrated, but the main efferent vein was not demonstrated. The arrow and arrowhead indicate an 8-F 50-cm-long sheath and a balloon, respectively. (D) Retrograde venography under balloon occlusion of the left gonadal vein performed after coil embolization of the collateral vein showed several small collateral veins connected with retroperitoneal veins. The collateral veins could be occluded by infusion of a small amount of 50% glucose solution (not shown). (E) Thereafter, infusions of ethanolamine oleate with iopamidol for 30 minutes were repeated three times through a microcatheter. The arrow indicates the inferior pancreaticoduodenal vein and the arrowhead indicates the microcatheter. (F) Contrast-enhanced computed tomography performed 4 days after balloon-occluded retrograde transvenous obliteration (BRTO) showed that the varices were completely thrombosed (arrows). The arrowhead indicates metallic coils in the anastomosis with retroperitoneal veins. (G) Endoscopy performed 4 months after BRTO showed the disappearance of the varices.

Fig. 2. A 60-year-old male with ruptured duodenal varices. (A) Contrast-enhanced computed tomography (CT) showed the varices in the second and third portions of the duodenum (arrows). The afferent vein was the inferior pancreaticoduodenal vein (asterisk) and the efferent vein drained into the right gonadal vein (arrowhead). (B) Endoscopy showed active bleeding from the duodenal varices. Hemostasis could be achieved by clipping (not shown). (C) Retrograde venography under balloon occlusion of the right gonadal vein did not demonstrate the main efferent vein. The arrow indicates the clip placed on the duodenal varices. (D) After coil embolization of the right gonadal vein, the main efferent vein was demonstrated. However, a retrograde venogram obtained through the microcatheter advanced into the main efferent vein demonstrated an anastomosis with the retroperitoneal veins (arrow). (E) Therefore, the collateral vein was also embolized with coils. Infusions of ethanolamine oleate with iopamidol for 30 minutes were then repeated three times. The arrow indicates the clip and the arrowhead indicates the inferior pancreaticoduodenal vein. The asterisk indicates the microcatheter. (F) Contrast-enhanced CT performed 3 days after balloon-occluded retrograde transvenous obliteration (BRTO) showed that the varices were completely thrombosed (arrows). The arrowhead indicates the clip placed on the varices and the asterisk indicates the inferior pancreaticoduodenal vein. (G) Endoscopy performed 1 week after BRTO showed an ulcer at the clipping site.

emergent BRTO was performed after endoscopic treatment to stop active bleeding from the varices.

BRTO technique

BRTO was performed via the right femoral or right internal jugular vein according to the branching direction of the estimated main draining pathway of the duodenal varices on CT. Before EOI infusion, 4,000 units of haptoglobin (Mitsubishi Tanabe, Osaka, Japan) were administered intravenously.

After local anesthesia, a 6- to 8-F 25-cm-long sheath (Medikit, Tokyo, Japan) was placed in the vein and a 5- to 6-F 9- to 20-mm diameter occlusion balloon catheter (Selecon MP catheter II; Terumo Clinical Supply, Kakamigahara, Japan) was advanced into the draining vein. A shaped 8-F 50-cm-long sheath (Medikit) was also used when the balloon catheter could not be advanced into the draining vein. If retrograde venography under balloon occlusion demonstrated the collateral veins, they were embolized with metallic coils (Micronester embolization coil or Tornado embolization microcoil; Cook, Bloomington, IN, USA) through a microcatheter (Progreat β^3 ; Terumo, Tokyo, Japan). If small collateral veins were still demonstrated after coil embolization, they were embolized by infusion of a small amount of 50% of glucose

solution or 5% EOI (a mixture of 10% ethanolamine oleate [Oidamin; Takeda, Osaka, Japan] and the same amount of iopamidol 300 mgI/mL [Iopamiron 300; Bayer, Osaka, Japan]) via the microcatheter. If EOI was infused, the same amount of blood with EOI was aspirated 10 minutes later. When the collateral veins disappeared and the main efferent vein was opacified, EOI was slowly infused for 30 minutes until the varices were filled. Infusions were repeated until the main efferent vein and varices, as well as the main afferent vein, were filled with EOI and clots and additional EOI did not fill the varices. The catheter and sheath were then withdrawn after the aspiration of residual EOI.

Follow-up

All patients underwent contrast-enhanced CT and endoscopy within 1 week after BRTO. If the varices were not sufficiently thrombosed, BRTO was repeated. Contrast-enhanced CT was repeated every 2 to 6 months after BRTO, mainly to check for the development of other collateral pathways, as well as hepatocellular carcinoma (HCC). Follow-up endoscopy was also performed every 4 to 12 months.

Results

Anatomy of duodenal varices

All varices were in the second and/or third portions of the duodenum (Fig. 1B, 2A). The main efferent vein drained into the right ($n = 4$; Fig. 2A) or left ($n = 2$; Fig. 1B) gonadal vein, and the main afferent vein was the inferior pancreaticoduodenal vein connected with the first ($n = 5$) or second ($n = 1$) jejunal vein (Fig. 1B).

Endoscopic treatment for ruptured varices

In the three patients with ruptured varices, hemostasis was achieved by clipping ($n = 1$; Fig. 2G) or endoscopic variceal ligation (EVL) ($n = 2$) immediately before BRTO.

BRTO procedures

The procedure was performed via the right femoral ($n = 4$) or right internal jugular vein ($n = 2$). The 8-F 50-cm-long sheath was used in two patients whose efferent vein drained into the left gonadal vein (Fig. 1C). In five patients, the main efferent vein was not demonstrated on the first retrograde venography under balloon occlusion of the draining vein because of dominant collateral flow through anastomoses with retroperitoneal veins (Fig. 1C, 2C). Therefore, coil embolization of 1–4 (mean, 2.4 ± 1.1) collateral veins, including the distal gonadal vein (Fig. 1D, 2D, 2E), and additional embolization of small collateral veins with 50% glucose solution in one patient (Fig. 1D) and 5% EOI in two patients were performed until the main efferent vein was opacified. In the remaining patient, embolization of the collateral veins was not required because the balloon catheter was directly advanced into the main efferent vein. Furthermore, 11–21 mL (mean, 15.3 ± 4.2 mL) of EOI was infused by 3 to 5 (mean, 3.5 ± 1.0) stepwise infusions in each patient (Fig. 1E, 2E). The duration of EOI infusion under balloon occlusion ranged from 82 to 118 minutes (mean, 87.8 ± 13.6 minutes) and the procedural time ranged from 120 to 210 minutes (mean, 172.8 ± 30.9 minutes).

Outcomes

The duodenal varices were completely thrombosed on contrast-enhanced CT performed 3 to 14 days after BRTO in five patients (Fig. 1F, 2F). In the remaining patient, who was the first case of this cohort, the varices were not thrombosed on CT performed 3 days after the procedure, but were thrombosed by additional BRTO performed 19 days after the initial BRTO procedure. At that time, 8 mL of EOI was infused into the varices for 30 minutes under balloon occlusion of the main efferent vein, then 5 mL of EOI was infused under balloon occlusion overnight (20 hours). In two patients with ruptured varices treated with EVL, endoscopy performed 4–6 days after BRTO showed that the ligated band had been lost and an ulcer had developed on the varices at the ligated site. In another patient who underwent clipping, the clip was still positioned on the varices 7 days later; however, an ulcer also developed at the clipping site (Fig. 2G).

During follow-up of 4–32 months (mean, 16.2 ± 11.1 months) after BRTO, all duodenal varices disappeared and induction of other varices was not observed (Fig. 1G). One patient died of HCC 28 months after BRTO despite several sessions of transarterial chemoembolization. Two patients were lost to follow-up at 4 and

32 months, respectively, after BRTO. Table 1 shows a summary of the patient outcomes.

Complications

No portal vein thrombi or symptoms related to clot migration developed in any patient. All patients presented with a transient fever (maximum, 37.8°C – 38.9°C ; for 2–6 days), for which no treatment was required, as well as hematuria.

Discussion

BRTO is a relatively new technique for the treatment of gastric varices,^{19,20} and it is often applied to duodenal varices.^{6–9,11–18} The advantages of BRTO over TIPS for duodenal varices are that it can completely embolize the targeted varices and that it does not reduce portal flow, avoiding further exacerbation of hepatic function and encephalopathy.¹⁰ In fact, no recurrent bleeding has been reported after successful BRTO treatment.^{8,11–18} PTO also requires catheterization into the portal vein through the liver and has a relatively high recurrence rate when used for the treatment of gastric varices.²¹ Additionally, its efficacy for duodenal varices has not been established, and it is often necessary to apply PTO in combination with BRTO.^{6–9} Therefore, BRTO is considered as the first-line endovascular intervention for duodenal varices, although it poses a risk of developing ascites and other varices due to the elevation of portal venous pressure.¹¹

However, BRTO for duodenal varices is frequently unsuccessful because underlying complex and multiple mesocaval collateral pathways can promote washout of EOI from varices. In addition, hepatofugal hemodynamic changes during balloon occlusion of the main draining vein make it difficult to treat duodenal varices by BRTO alone.¹¹ Therefore, an additional procedure, such as intravariceal injection of *n*-butyl-2-cyanoacrylate, coil embolization of the afferent vein, or simultaneous balloon occlusion of the afferent vein or the main portal trunk, is frequently required.^{9,11–13} In our experience, however, six consecutive patients with duodenal varices were successfully treated with BRTO, although embolization of collateral veins was required in five patients (83.3%). Although it is unclear why it was possible for our patients to be treated with BRTO alone, we suggest that stepwise EOI infusions might contribute to complete BRTO for duodenal varices.

Stepwise infusions of EOI at intervals of 3–15 minutes can be used as a technique to avoid insufficient filling of the varices.²⁰ The portion of the varices or efferent vein that initially fills with EOI is obliterated by the thrombus that forms during these intervals, and further infusions of EOI then fill another portion of the varices. This technique can also occlude small collateral pathways that cause washout of EOI from the duodenal varices; as a result, sufficient stagnation of EOI in the duodenal varices can be achieved. However, stepwise EOI infusion may also have a limited effect on large and/or high-flow collateral pathways and an additional approach may be required if such collaterals cannot be embolized with coils via the retrograde route.

In cases with ruptured duodenal varices, endoscopic treatment, such as injection sclerotherapy,³ EVL,^{4,8,15} or clipping,^{5,16} should be performed to stop bleeding. However, endoscopic treatment fails in some patients¹³ and cannot achieve long-term hemostasis.⁸ Moreover, it has risks of tissue damage, perforation, and progression of bleeding. However, BRTO usually takes a relatively long time and involves a risk of leakage of EOI through the bleeding point of the varices. Therefore, endoscopic treatment first, followed by BRTO, is a reasonable treatment strategy for ruptured

duodenal varices.^{15,16} In our three patients with ruptured varices, hemostasis could be achieved by endoscopic treatment. However, endoscopy performed 4 to 7 days after the procedure showed ulcer formation at the treatment site. This indicates that hemostasis of ruptured duodenal varices by endoscopic treatment might be temporary and additional BRTO is necessary to achieve complete hemostasis. If endoscopic treatment results in failure, PTO, a combination of PTO and BRTO, or TIPS would be other options.^{9-10,12}

A standard balloon occlusion time in BRTO for duodenal varices has not been established. Most investigators have performed overnight balloon occlusion to prevent clot migration,^{8,14} however, it may cause dislodgement of a balloon catheter and place a burden on patients. We removed the balloon catheter after EOI infusion for 82 to 118 minutes under balloon occlusion and no symptoms related to clot migration were observed. Therefore, we suggest that overnight balloon occlusion may be unnecessary if sufficient EOI is infused until further infusions of EOI do not fill the varices, although overnight occlusion was effective for varices that were not thrombosed by EOI infusion with 107 minutes of occlusion in our first case. We have also performed 83 BRTO procedure for gastric varices or symptomatic portosystemic shunts leading to hepatic encephalopathy in the same fashion and no clot migration has been experienced (unpublished data). We only performed overnight balloon occlusion in one patient with a short portosystemic shunt, besides the patient with duodenal varices in the present study.

The efferent vein of duodenal varices usually drains into the right side of the inferior vena cava (IVC), mainly into the right gonadal vein,^{9,11-15} and infrequently into the right renal subcapsular vein,¹¹ right inferior adrenal vein,¹⁷ and right side of the IVC.⁸ However, the Retzius vein (mesocaval shunt) is also present between the superior mesenteric and left gonadal veins;^{11,22} therefore, duodenal varices can also drain into the left gonadal vein.¹⁸ Of our six patients, two had an efferent vein draining into the left gonadal vein; therefore, clinicians should also pay attention to this drainage route when planning a BRTO procedure.

There are several limitations of this study. First, the number of patients in our cohort was quite small; therefore, there is a possibility that we encountered only simple duodenal varices. Second, in one patient, the varices could not be thrombosed by EOI infusion for 107 minutes. We supposed that one or more stepwise EOI infusions might be necessary in the first BRTO procedure. Additionally, clot migration might have developed after removal of the balloon catheter, although the patient presented with no symptoms.

In conclusion, BRTO is an effective treatment option for duodenal varices. In our limited experience, all six patients were successfully treated with BRTO by adding embolization of collateral veins, including one patient who underwent two sessions. Further research with a larger number of cases is necessary to establish a standard BRTO procedure for duodenal varices.

Funding

None.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

ORCID

Shiro Miyayama, <https://orcid.org/0000-0001-6119-5874>
Masashi Yamashiro, <https://orcid.org/0000-0003-4700-0756>
Rie Ikeda, <https://orcid.org/0000-0003-2163-1031>
Junichi Matsumoto, <https://orcid.org/0000-0002-0190-7806>
Nobuhiko Ogawa, <https://orcid.org/0000-0001-7921-0526>
Kazuo Notsumata, <https://orcid.org/0000-0002-1211-3227>

References

- Amin R, Alexis R, Korzis J. Fatal ruptured duodenal varix: a case report and review of literature. *Am J Gastroenterol*. 1985;80:13-8.
- Khouqeer F, Morrow C, Jordan P. Duodenal varices as a cause of massive upper gastrointestinal bleeding. *Surgery*. 1987;102:548-52.
- Ota K, Shirai Z, Masuzaki T, Tanaka K, Higashihara H, Okazaki M, et al. Endoscopic injection sclerotherapy with n-butyl-2-cyanoacrylate for ruptured duodenal varices. *J Gastroenterol*. 1998;33:550-5.
- Tazawa J, Sakai Y, Koizumi K, Asahina Y, Tajiri K, Yamaoka K, et al. Endoscopic ligation for ruptured duodenal varices. *Am J Gastroenterol*. 1995;90:677-8.
- Okoli A, Raymond P, Ammannagari N, Merrell N. Isolated duodenal varices as the initial presentation of hepatocellular carcinoma. *BMJ Case Rep*. 2013;2013:bcr-2013-201470.
- Copelan A, Chehab M, Dixit P, Cappell MS. Safety and efficacy of angiographic occlusion of duodenal varices as an alternative to TIPS: review of 32 cases. *Ann Hepatol*. 2015;14:369-79.
- Saad WE, Sze DY. Variations of balloon-occluded retrograde transvenous obliteration (BRTO): balloon-occluded antegrade transvenous obliteration (BATO) and alternative/adjunctive routes for BRTO. *Semin Intervent Radiol*. 2011;28:314-24.
- Takamura K, Miyake H, Mori H, Terashima Y, Ando T, Fujii M, et al. Balloon occluded retrograde transvenous obliteration and percutaneous transhepatic obliteration for ruptured duodenal varices after operation for rectal cancer with multiple liver metastasis: report of a case. *J Med Invest*. 2005;52:212-7.
- Ikeda O, Nakasone Y, Beppu T, Baba H, Yamashita Y. Successful treatment of ruptured duodenal varices with dual balloon-occluded embolotherapy. *Acta Radiol Short Rep*. 2012;1:arsr.2012.120008.
- Lopera JE, Arthurs B, Scheuerman C, Sandoz C, Petersosn S, Castaneda-Zuniga W. Bleeding duodenal: varices treatment by TIPS and transcatheter embolization. *Cardiovasc Intervent Radiol*. 2008;31:431-4.
- Okahara M, Kiyosue H, Ueda S, Kashiwagi J, Tanoue S, Hongo N, et al. Anatomic features and retrograde transvenous obliteration of duodenal varices associated with mesocaval collateral pathway. *J Vasc Interv Radiol*. 2012;23:1339-46.
- Zamora CA, Sugimoto K, Tsurusaki M, Izaki K, Fukuda T, Matsumoto S, et al. Endovascular obliteration of bleeding duodenal varices in patients with liver cirrhosis. *Eur Radiol*. 2006;16:73-9.
- Hashimoto R, Sofue K, Takeuchi Y, Shibamoto K, Arai Y. Successful balloon-occluded retrograde transvenous obliteration for bleeding duodenal varices using cyanoacrylate. *World J Gastroenterol*. 2013;19:951-4.
- Haruta I, Isobe Y, Ueno E, Toda J, Mitsunaga A, Noguchi S, et al. Balloon-occluded retrograde transvenous obliteration (BRTO), a promising nonsurgical therapy for ectopic varices: a case report of successful treatment of duodenal varices by BRTO. *Am J Gastroenterol*. 1996;91:2594-7.
- Akazawa Y, Murata I, Yamao T, Yamakawa M, Kawano Y, Nomura N, et al. Successful management of bleeding duodenal varices by endoscopic variceal ligation and balloon-occluded retrograde transvenous obliteration. *Gastrointest Endosc*. 2003;58:794-7.
- Ohta M, Yasumori K, Saku M, Saito H, Muranaka T, Yoshida K. Successful treatment of bleeding duodenal varices by balloon-occluded retrograde transvenous obliteration: a transjugular venous approach. *Surgery*. 1999;126:581-3.
- Hotta M, Yoshida H, Mamada Y, Tani N, Bando K, Mizuguchi Y, et al. Successful management of duodenal varices by balloon-occluded retrograde transvenous obliteration. *J Nippon Med Sch*. 2008;75:36-40.
- Hwang SW, Sohn JH, Kim TY, Kim JY, Yhi J, Kwak DS, et al. Long-term successful treatment of massive distal duodenal variceal bleeding with balloon-occluded retrograde transvenous obliteration. *Korean J Gastroenterol*. 2014;63:248-52.
- Kanagawa H, Mima S, Kouyama H, Gotoh K, Uchida T, Okuda K. Treatment of gastric fundal varices by balloon-occluded retrograde transvenous obliteration. *J Gastroenterol Hepatol*. 1996;11:51-8.
- Kiyosue H, Mori H, Matsumoto S, Yamada Y, Hori Y, Okino Y. Transcatheter obliteration of gastric varices: Part 2. Strategy and techniques based on hemodynamic features. *Radiographics*. 2003;23:921-37; discussion 937.
- Arai H, Abe T, Takagi H, Mori M. Efficacy of balloon-occluded retrograde transvenous obliteration, percutaneous transhepatic obliteration and combined techniques for the management of gastric fundal varices. *World J Gastroenterol*. 2006;12:3866-73.
- Ibukuro K, Tsukiyama T, Mori K, Inoue Y. Veins of Retzius at CT during arterial portography: anatomy and clinical importance. *Radiology*. 1998;209:793-800.