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Radiologic Variations in Gastrorenal Shunts and Collateral Veins from Gastric Varices in Images Obtained Before Balloon-Occluded Retrograde Transvenous Obliteration

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Abstract

Purpose: To investigate variations in the features of gastrorenal shunts and collateral veins shown by balloon-occluded retrograde venography (B-RTV) and by superior mesenteric and celiac arteriography.
Methods: A retrospective analysis was performed of the variation in these features on B-RTV and arteriography images obtained from 130 patients who have undergone these studies prior to balloon-occluded retrograde transvenous obliteration at our hospital since 1993.
Results: At least one gastrorenal shunt was revealed in 97% (126/130) of cases. Types of gastrorenal shunts observed were as follows: only one main gastrorenal shunt, 94% (118/126) of cases; two main gastrorenal shunts with a ring-like appearance, 3% (4/126); and some gastrorenal shunts to the left renal vein, 3% (4/126). Collateral veins detected were as follows: left inferior phrenic vein, 75% (95/126) of cases; pericardiacophrenic vein, 40% (50/126); gonadal vein, 13% (16/126); retroperitoneal veins, 65% (82/126).
Conclusion: It is very important to know the exact configuration of any gastrorenal shunts in order to guide advancement of the balloon catheter into the shunt and to avoid unexpected injection of the sclerosing agent.

Key words: Anatomy—B-RTO—Gastric varices—Gastrorenal shunt

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Introduction

In Japan, balloon-occluded retrograde transvenous obliteration (B-RTO) has been performed since the early 1990s to treat gastric varices for which curative endoscopic treatment is difficult, and favorable treatment results have been reported [1–4]. However, the time needed for the procedure and the use of a sclerosing agent in each case depend on the type of gastrorenal shunt, the degree of development of collateral veins toward the systemic circulation from varices other than the gastrorenal shunt, the size of varices, and the volume of blood flow. A few anatomic and angiographic studies for gastric varices and collateral veins have been reported [5, 6]. Portal hypertension causes regurgitation in the short gastric vein, posterior gastric vein, or left gastric vein, and this induces the formation of gastric varices. The blood from gastric varices is drained to a vertical branch of the left inferior phrenic vein, then to the left adrenal vein, and finally into the left renal vein [6–9]. This dilated route is called a gastrorenal shunt. However, the drainage route from gastric varices is not always the same, and other collateral veins are often seen [4] (Fig. 1). Therefore, accurate information about the variation of outflow patterns of gastrorenal shunts is very important to enable the procedure to be completed successfully and easily. In the present study, we examined variations in gastrorenal shunts and collateral veins from gastric varices by a retrospective analysis of angiographic findings.

Materials and Methods

It is essential to have accurate information about collateral veins in order to succeed in B-RTO for gastric varices. Therefore, we studied the outflow pattern of gastrorenal shunts in 130 patients.

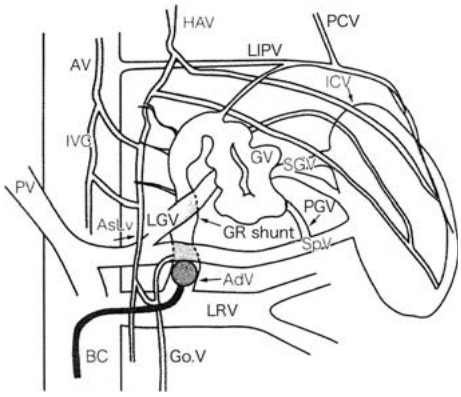

Fig. 1. Schema of the gastric varices and collateral veins. GV, gastric varices; IVC, inferior vena cava; LRV, left renal vein; PV, portal vein; SpV, splenic vein; LGV, left gastric vein; PGV, posterior gastric vein; SGV, short gastric vein; GR shunt, gastrorenal shunt; AdV, adrenal vein; LIPV, left inferior phrenic vein; Go.V, gonadal vein; PCV, pericardiacophrenic vein; ICV, intercostal vein; AV, azygos vein; HAV, hemiazygos vein; AsLV, ascending lumbar vein; BC, balloon catheter.

Patient Characteristics

During the period February 1993 through November 2004, 130 patients with gastric varices (81 men, 49 women; average age 63.3 years, range 39–86 years) were enrolled in this study. All patients were previously diagnosed with gastrointestinal endoscopy as having gastric varices. When they had Red-Color signs, endoscopic injection sclerotherapy or/and endoscopic variceal ligation had been performed. All 130 patients underwent superior mesenteric arteriography and celiac arteriography in preparation for B-RTO at our hospital. B-RTO is indicated when the gastric varices have feeding veins and draining veins emptying into the systemic circulation such as a gastrorenal shunt or inferior phrenic vein. When there is a gastrorenal shunt, balloon-occluded retrograde venography (B-RTV) is subsequently performed. Four patients without a gastrorenal shunt were excluded from evaluation of collateral veins using B-RTV. B-RTVs in the first session of B-RTO were evaluated, although 28 patients underwent multiple sessions of B-RTO.

Superior Mesenteric Arteriography and Celiac Arteriography

A 5 Fr sheath (Terumo, Tokyo, Japan) was inserted into the left femoral vein and a 5 Fr C-shaped catheter (Clinical Supply, Gifu, Japan) was selectively inserted into the superior mesenteric artery and celiac artery. Nonionic contrast medium (350 mg I/ml) was then injected into each artery at a rate of 5 ml/sec for 5 sec using an injector. We evaluated only the hemodynamics of gastric varices because minute vessels were not visualized in the venous phase of arteriography.

B-RTV

An 8 Fr guiding sheath (Medikit, Tokyo, Japan) was inserted into the left renal vein from the right femoral vein. Subsequently, a 6 Fr balloon catheter (Selecon MP catheter, Clinical Supply, Gifu, Japan) was selectively inserted into the gastrorenal vein, and the balloon was inflated in the lower part of the gastrorenal shunt. Digital subtraction angiography was obtained with slow hand-injection of contrast medium (300 mg I/ml) from the balloon catheter under balloon occlusion of outflow of the gastrorenal shunt until an afferent vein such as a posterior gastric vein was visualized. Even when the afferent vein was not visualized because of the development of collateral veins, the maximum dose of contrast medium was set at 20 ml. Minute collateral veins were well depicted on venography by hand-injection. The reason for using hand-injection to obtain a venogram was to avoid rupture of gastric varices due to mandatory pressure by a mechanical injector.

Analysis of Variation

Two radiologists evaluated the variation in outflow of the gastrorenal shunt and collateral veins from all angiography including arteriography and B-RTV.

The presence/absence of a gastrorenal shunt was studied using superior mesenteric arteriography, and the variation in the shunt was studied using B-RTV.

In patients in whom a gastrorenal shunt was detected, the presence/absence of depiction by B-RTV of such collateral veins as a left inferior phrenic vein (LIPV), a pericardiacophrenic vein (PCV), a gonadal vein (Go.V), and a small retroperitoneal vein (RV) was determined. In this study, we defined a collateral LIPV as a horizontal branch of the LIPV and an RV as a small retroperitoneal vein such as an ascending lumbar vein, a hemiazygos vein, or an azygos vein. In patients without a gastrorenal shunt, B-RTV was performed via other draining vein such as a LIPV. However, these cases were excluded from evaluation of collateral veins.

Informed consent for B-RTO was obtained from all patients, but we did not seek IRB approval because this study was retrospective and B-RTO has been a very popular procedure in our country.

Results

No gastrorenal shunt was detected by B-RTV and arteriography in 4 of the 130 patients (3%, 4/130). There were 118 patients who had one gastrorenal shunt (94%, 118/126) (Figs. 2A, 3A), and multiple gastrorenal shunts were detected in 8 patients (6%, 8/126). The multiple shunts were classified according to their configurations as of either ''ring type'' or ''streaks type.''

The ring type of gastrorenal shunt divides into two shunts on the side closer to the varices and the two merge again near the left renal vein, into which they drain. This type was detected in 4 patients (3%, 4/126) (Figs. 2B, 3B). The streaks type of gastrorenal shunt divides into multiple streaks, draining to the left renal vein without merging again. This type was also detected in 4 patients (3%, 4/126) (Figs. 2C, 3C). In the 126 patients in whom a gastrorenal shunt was detected, we studied depiction rates of various collateral veins on B-RTV. LIPV collaterals were depicted in 75% (95/126) of these patients, PCV in 40% (50/126), Go.V in 13% (16/126), and RV in 65% (82/126) (Table 1; Fig. 4). The frequency of ''no collateral vein'' was 14/126

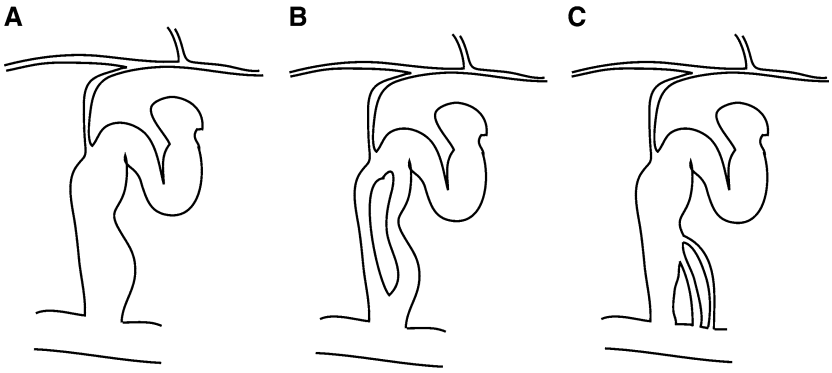

Fig. 2. A–C. Schema of outflow patterns of gastrorenal shunts. **A** Standard gastrorenal shunt. **B** ''Ring type'': this shunt divides into two shunts on the side closer to the varices and the two merge again near the left renal vein, into which they drain. **C** ''Streaks type'': this shunt divides into multiple streaks, draining into the left renal vein without merging again.

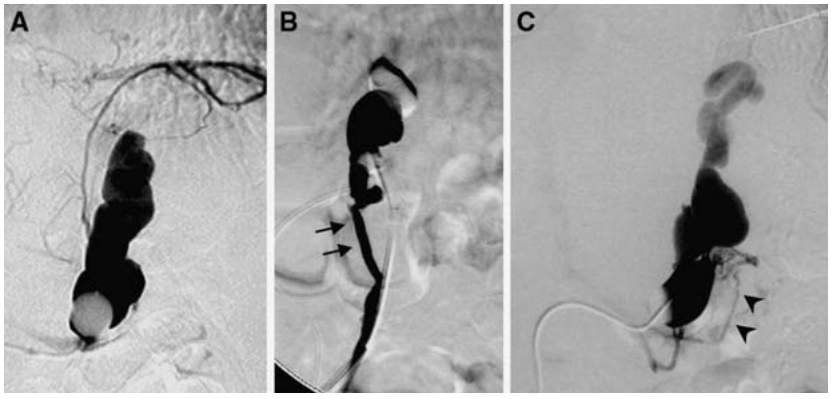

Fig. 3. A–C. B-RTV images of outflow patterns of gastrorenal shunts. **A** One gastrorenal shunt: the most commonly seen variation. **B** ''Ring type'': when one gastrorenal shunt is occluded by balloon inflation, contrast medium overflows into the left renal vein through the other gastrorenal shunt (arrow). When the two merge into the left renal vein, they become a single gastrorenal shunt. **C** ''Streaks type'': although one dilated gastrorenal shunt is occluded by balloon inflation, other minute gastrorenal shunts (arrowhead) flow directly into the left renal vein.

Table 1. Depiction of collateral veins

	(n = 126)
LIPV	75 (95/126)
PCV	40 (50/126)
RV	65 (82/126)
Go.V	13 (16/126)

LIPV, left inferior phrenic vein; PCV, pericardiacophrenic vein; RV, retroperitoneal veins (ascending lumbar, hemiazygos, etc.); Go.V, gonadal vein.

(11%), that of ''single collateral vein'' was 31/126 (25%), and that of ''multiple collateral veins'' was 81/126 (64%). The most frequent combination of collateral veins was ''LIPV + PCV + RV'' (25%, 32/126), and the next most frequent was ''LIPV + RV'' (21%, 26/126).

In this study, esophageal varices through sudare veins were not visualized on B-RTV.

Discussion

The use of B-RTO was first described by Kanagawa et al. [1] in the early 1990s, and the procedure has been used with favorable results [2–4] as a treatment for gastric varices and hepatic encephalopathy due to gastrorenal shunt. Ectopic varices such as duodenal varices have also been treated successfully with this procedure [10–13]. In the B-RTO procedure, it is common to insert a balloon catheter into the gastrorenal shunt from the inferior vena cava through the left renal vein via the femoral vein or the jugular vein, occlude the gastrorenal shunt by balloon inflation, and inject sclerosing agent into the gastric varices. However, even though the gastrorenal shunt is occluded by balloon inflation, if another collateral vein has developed as a draining vein, the sclerosing agent does not remain within the gastric varices; in such cases, effective treatment cannot be expected. Therefore, it is necessary to perform an additional procedure such as embolization of the collateral veins with metallic coils or absolute ethanol. Thus, it is important to be aware of the configuration of the gastrorenal shunt and collateral veins before the procedure is performed. However, there have been few reports on the variations in gastrorenal shunt configurations.

The limitation of this study is that B-RTV is retrograde venography. Therefore, it does not reveal the whole image of portosystemic shunts, though it does show important

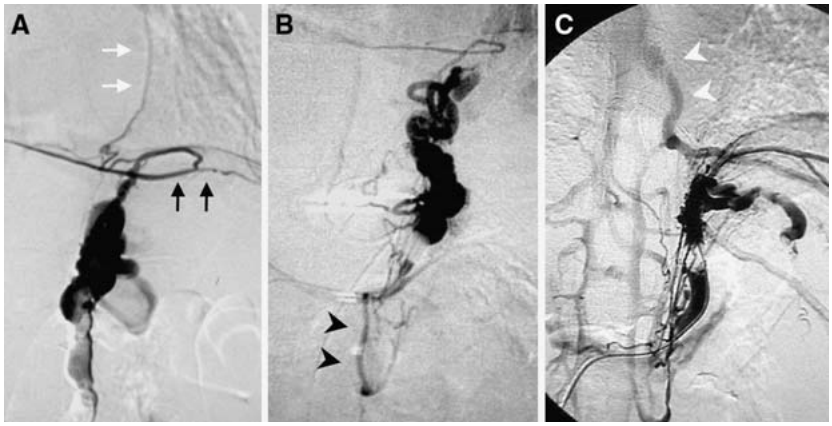

Fig. 4. A–C. B-RTV images of types of collateral veins. **A** Left inferior phrenic vein (arrows) and pericardiacophrenic vein (white arrows). **B** Gonadal vein (arrowheads). **C** Retroperitoneal veins (white arrowhead).

Fig. 5. Collateral veins in a patient with no gastrorenal shunt. B-RTV under balloon inflation of the left inferior phrenic vein (arrow) reveals no gastrorenal shunt. A posterior gastric vein (white arrow) and short gastric vein (arrowheads) are depicted as feeding veins into the gastric varices retrogradely.

information about collateral veins because the flow of contrast medium in B-RTV is the same as the flow of sclerosing agent in B-RTO.

Knowledge of the exact outflow variation of a gastrorenal shunt allows an optimal technique for B-RTO. For example, when gastric varices have no gastrorenal shunt, it is impossible to perform standard B-RTO. If the dilated LIPV is the only draining vein from gastric varices, it is possible to complete B-RTO by inserting a balloon catheter into the LIPV through the inferior vena cava [14] (Fig. 5). Standard B-RTO is performed when there is one gastrorenal with minute collateral veins. ''Stepwise injection'' [15] or the ''downgrading method'' [16] is tried when there is one gastrorenal shunt with developing collateral veins. The RV and Go.V anastomose relatively frequently to the lower part of the gastrorenal shunt, and the LIPV and PCV anastomose to the upper part of the gastrorenal shunt. The downgrading method can prevent the sclerosing agent from draining through collateral veins. Serious pericardial complications due to B-RTO have not been reported, but overflow of sclerosing agent into the PCV might cause complications in the pericardium. When we are not able to use the downgrading method, we try to occlude any collateral vein with metallic coils or/and absolute ethanol via a microcatheter [17]. We occasionally try to retrogradely insert another balloon catheter into a developed collateral vein such as the LIPV via the inferior vena cava or PCV via the left brachiocephalic vein, and occlude it with the balloon. This method is called ''dual balloon-occluded retrograde transvenous obliteration'' [18].

In this report on multiple gastrorenal shunts we have classified them into shunts of ring type or streaks type. When the outflow pattern is of the ring type, we can use two methods, which are done under balloon occlusion at the upper or lower part of the ring. B-RTO under balloon occlusion at one side of the ring does not succeed (Fig. 6). For shunts of the streaks type, the downgrading method or stepwise injection can be chosen.

Conclusion

We evaluated the outflow pattern of gastrorenal shunts and the frequency of radiological depiction of collateral veins associated with gastric varices. This is the first report on multiple gastrorenal shunts and we classified them into ''ring type'' and ''streaks type.'' Together with this classification, the information that was obtained using B-RTV allows an optimal technique of B-RTO.

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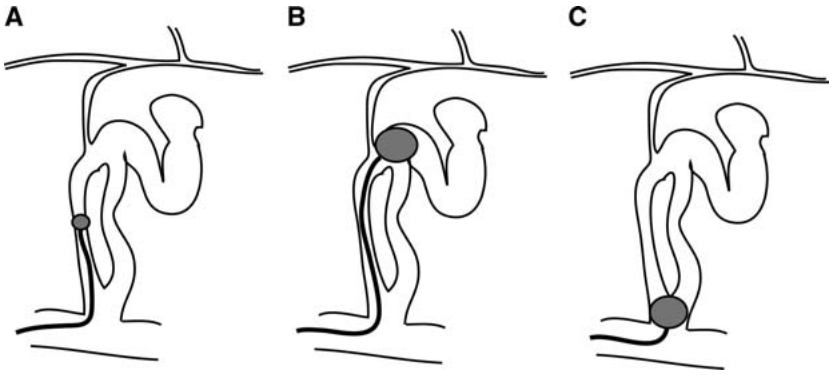

Fig. 6. A–C. Optimal positioning of the balloon catheter for B-RTO in cases of shunts of the ring type: **A** one side, **B** upper part, **C** lower part. Although it is advisable to insert a balloon into the upper part of the gastrorenal shunt, it is still possible to perform B-RTO by balloon inflation in the gastrorenal shunt near the left renal vein.

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