Hemodynamic Changes after Balloon Occlusion of the Splenic Artery during Balloon-occluded Retrograde Transvenous Obliteration for Gastric Varices

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ABSTRACT

Purpose: To elucidate changes in hemodynamics after balloon occlusion of the splenic artery during balloon-occluded retrograde transvenous obliteration (B-RTO).

Materials and Methods: In eight patients who had B-RTO for a gastric varix, the balloon-occluded venous pressure of the drainage vein was measured, and balloon-occluded retrograde venography (B-RTV) was performed with and without occlusion of the splenic artery during B-RTO. The pressure and the degrees of the variceal complex visualized on B-RTV were compared between those with and without occlusion of the splenic artery.

Results: In seven of the eight patients, balloon-occluded venous pressure of the drainage vein decreased after balloon occlusion of the splenic artery. A paired *t* test showed that the mean decrease from 21.88 mm Hg to 18.38 mm Hg was statistically significant ($P = .0033$). From findings of B-RTV, the variceal complex was more extensively visualized after occlusion of the splenic artery in seven of the eight patients.

Conclusions: Balloon occlusion of the splenic artery during B-RTO for gastric varices can produce changes in hemodynamics related to gastric varices and has the potential to prompt the sclerosing agent to distribute more extensively and evenly in the gastric varix.

ABBREVIATIONS

B-RTO = balloon-occluded retrograde transvenous obliteration, B-RTV = balloon-occluded retrograde venography, EOI = ethanolamine oleate iopamidol, PSE = partial splenic arterial embolization

Gastric varices are a complication of portal hypertension (1–3), although less common than esophageal varices (1). However, when gastric varices bleed, the mortality rate without therapy is high: 45%–55% (1,4,5). Thus, quick management of bleeding gastric varices is necessary.

Balloon-occluded retrograde transvenous obliteration (B-RTO) is known to be effective for gastric varices caused by portal hypertension (6–8). Disappearance or regression of gastric varices after B-RTO can be achieved at a high rate, ranging from 90% to 100%, according to previous reports (5–10). However, some situations, such as the existence of multiple afferent veins (11) or a large and tortuous shunt (12), make it difficult to fill an entire gastric varix with the sclerosing agent, resulting in incomplete obliteration of the gastric varix.

Recently, temporary balloon occlusion of the splenic artery was reported to be a useful additional technique for complete obliteration of gastric varices in such cases (11–13). We undertook the present study to elucidate changes in hemodynamics after balloon occlusion of the splenic artery during B-RTO.

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Table 1. Characteristics of Patients who Underwent Balloon-occluded Retrograde Transvenous Obliteration for Gastric Varices

Pt. No./Age (y)/ Sex	Cause of Liver Cirrhosis	Child–Pugh Score	MELD Score	HCC	CT Finding	
					Drainage Vein	Afferent Veins
1/68/M	Hepatitis C	A	7	Yes	Gastrorenal shunt	Posterior gastric vein, LGV
2/76/F	Hepatitis C	B	9	Yes	Gastrorenal shunt	Posterior gastric vein, short gastric vein (single)
3/71/M	Hepatitis C	A	7	Yes	Left inferior phrenic vein	Short gastric veins (multiple)
4/61/M	Chronic alcohol ingestion	B	9	No	Gastrorenal shunt	Posterior gastric vein
5/72/M	Hepatitis C	A	7	No	Gastrorenal shunt	Short gastric veins (multiple), LGV
6/73/M	NASH	A	9	No	Gastrorenal shunt	Posterior gastric vein
7/67/M	Hepatitis C	A	8	Yes	Gastrorenal shunt	Posterior gastric vein, short gastric vein (single), LGV into gastrorenal shunt
8/61/M	Chronic alcohol ingestion	A	8	No	Gastrorenal shunt	Posterior gastric vein, short gastric vein (single), LGV into gastrorenal shunt

HCC = hepatocellular carcinoma, LGV = left gastric vein, MELD = Model for End-stage Liver Disease, NASH = nonalcoholic steatohepatitis.

MATERIALS AND METHODS

Patients

Between March 2011 and September 2011, eight patients (seven men, one woman; mean age, 67 y; range, 61–76 y) underwent B-RTO for gastric varices. All had a gastrorenal shunt except one patient in whom the gastric varix was drained through the left inferior phrenic vein. The characteristics of the eight patients are summarized in **Table 1**. Causes of their liver cirrhosis were hepatitis C (n = 5), chronic alcohol ingestion (n = 2), and nonalcoholic steatohepatitis (n = 1). According to the Child–Pugh classification, six patients had class A disease and two had class B disease. Model for End-stage Liver Disease scores were 7 in three patients, 8 in two patients, and 9 in three patients. Four patients had concomitant hepatocellular carcinoma. Enhanced abdominal computed tomography (CT) before B-RTO showed that gastric varices were supplied by multiple veins in six of the eight patients. Afferent veins in eight patients were the posterior gastric vein (n = 6), short gastric vein (n = 5), and left gastric vein (n = 2). In two patients, the left gastric vein directly drained into the gastrorenal shunt without ingression to the gastric varices.

In all eight patients, during the B-RTO procedure, balloon-occluded retrograde venography (B-RTV) and measurement of balloon-occluded venous pressure of the drainage vein with and without occlusion of the splenic artery were performed to evaluate changes in hemodynamics of afferent and drainage veins.

Approval was obtained from the institutional ethics committee. After patients provided written informed consent, the procedure was performed by one of four interventional radiologists in our hospital system experienced in the B-RTO procedure.

B-RTV and Balloon-occluded Drainage Vein Pressure Measurement Procedures

A 6-F balloon catheter with a balloon 20 mm in diameter (Selecon; Terumo/Clinical Supply, Gifu, Japan) was inserted into the drainage vein such as the gastrorenal shunt (n = 7) or a 3.3-F microballoon catheter (Fuji Systems, Fukushima, Japan) was inserted into the left inferior phrenic vein (n = 1). Concurrently, a 5-F balloon catheter with a diameter of 11 or 9 mm (Moiyan [Miyano medical instruments, Hyogo, Japan] or Selecon [Terumo/Clinical Supply]) or a 3.3-F microballoon catheter (Fuji Systems) was advanced to the splenic artery.

B-RTV and Balloon-occluded measurement of balloon-occluded venous pressure of the drainage vein with and without occlusion of the splenic artery were performed as follows. First, the balloon in the drainage vein was inflated, and B-RTV without occlusion of the splenic artery was performed. Contrast material was infused manually until visualization of the gastric varix occurred. When blood flow into a collateral drainage vein other than the drainage vein that was occluded by the balloon catheter, or into the left gastric vein that directly drained into the gastrorenal shunt, was too abundant to allow visualization of the gastric varix, the maximum dose of contrast material was limited to within 10 mL. Contrast material was then cleared by deflating the balloon. Second, the balloon in the drainage vein was inflated again, and balloon-occluded venous pressure of the drainage vein was measured. Third, the balloon in the splenic artery was inflated, and balloon-