Hiroshima J. Med.Sci.
Vol. 60, No. 1, 15~19, March, 2011
HIJM 60−4

Portal-Systemic Shunt between the Inferior Mesenteric Vein and Inferior Vena Cava in a Patient with Hepatic Encephalopathy: Successful Occlusion by Balloon-Occluded Retrograde Transvenous Obliteration

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ABSTRACT

A large shunt between the inferior mesenteric vein (IMV) and the inferior vena cava (IVC) is a rare type of portosystemic shunt in patients with hepatic encephalopathy. We report a patient with hepatic encephalopathy due to a large IMV-IVC shunt who was successfully treated by balloon-occluded retrograde transvenous obliteration. The procedure involved a combination of 11 metallic coils and 5 ml of 5% ethanolamine oleate with iopamidol as the sclerosing agent. After complete obliteration of the shunt, his symptoms disappeared. At 2-years follow-up he was free of clinical symptoms, the size of his liver had slightly increased, and his liver function was preserved.

Key words: *BRTO, Hepatic encephalopathy, Portal-systemic shunt*

In the presence of portal hypertension, large extrahepatic portosystemic venous shunts can lead to hepatic encephalopathy. The development of a large shunt between the inferior mesenteric vein (IMV) and the inferior vena cava (IVC) as collateral vessels leading to hepatic encephalopathy is extremely rare[2], although several anastomoses develop between the portal venous system and the IVC at the peritoneum[5]. Balloon-occluded retrograde transvenous obliteration (BRTO), used to treat solitary gastric varices, is also useful for the treatment of portosystemic encephalopathy due to spleno- and gastrorenal shunts[2]. The successful treatment of IMV-IVC shunts has been reported; it produced significant improvements without eliciting severe complications[3,7,9,10]. We successfully treated a patient with encephalopathy due to a direct IMV-IVC shunt by BRTO.

CASE REPORT

The institutional review board of our institution does not require approval for retrospective case reports.

This 74-year-old man with liver cirrhosis was negative for hepatitis B surface antigen and antibody to hepatitis C virus; he was admitted to our hospital with hepatic encephalopathy that failed to respond to conservative treatment. On physical examination he was disoriented and manifested flapping tremor. He had no history of abdominal surgery or trauma. At admission his blood ammonia level was 175 μg/dL (normal range, 14-40 μg/dL), his Child-Pugh score was 6, and his Child-Pugh classification was class A. Contrast-enhanced computed tomography (CT) (Fig. 1A) revealed that the IMV was markedly dilated and drained directly into the left aspect of the IVC at a level below the confluence of the left renal vein in addition to the atrophic liver. The maximum diameter of the main trunk of the portal vein (8 mm) was almost equal to the maximum diameter of the splenic vein (9 mm) and smaller than the

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maximum diameter of the superior mesenteric vein (SMV) (13 mm) and the IMV (16 mm), suggesting that most of the portal blood flow from both the SMV and splenic vein drained into the IVC through the shunt, resulting in hepatic encephalopathy. The caudal portion of the shunt was tortuous and markedly dilated (diameter 16 mm); the outlet orifice of the shunt was 10 mm in diameter, smaller than the diameter of the variceal portion.

Written prior informed consent was obtained from him and his family before BRTO. We inserted a 5-F catheter with a 2 cm-diameter balloon (Selecon balloon catheter; Terumo Clinical Supply,

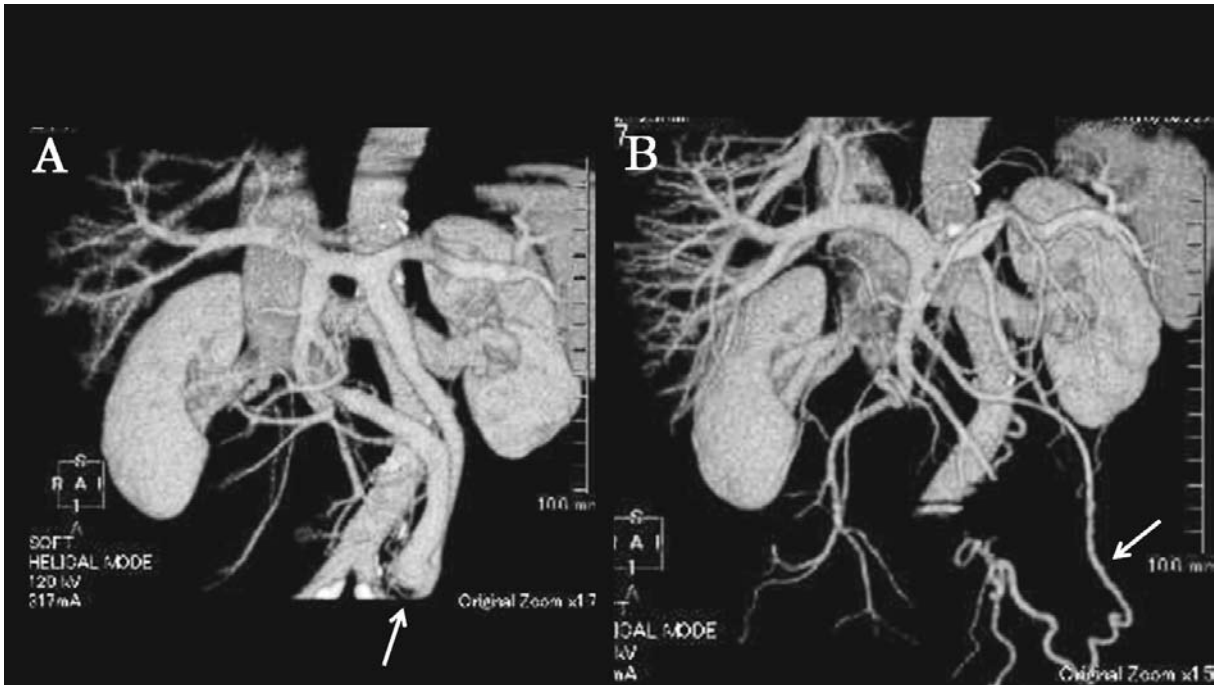

Fig. 1. Three-dimensional image obtained by contrast-enhanced CT.
(A) Before BRTO. A dilated IMV-IVC is demonstrated. The diameter of the main trunk of the portal vein was almost equal to or smaller than the diameter of the splenic vein, SMV, and IMV. The caudal portion of the shunt (arrow) was tortuous and markedly dilated.
(B) One year after BRTO. The IMV-IVC shunt had disappeared. Note the newly-developed marginal draining vein from the descending and sigmoid colon (arrow). The size of the main trunk of the portal vein is larger than that of pre-BRTO.

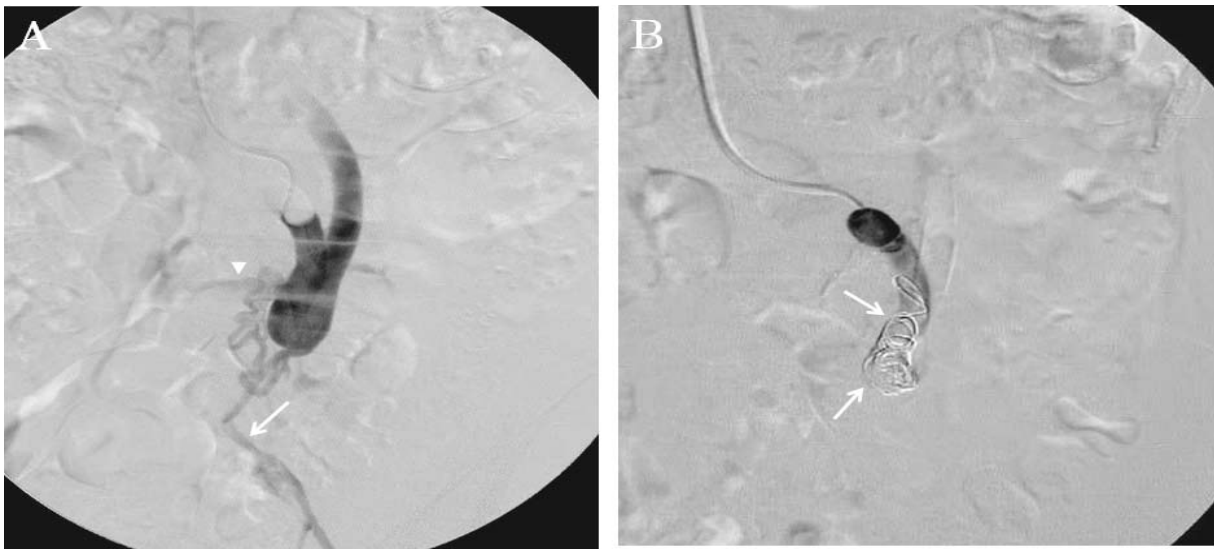

Fig. 2. Retrograde transvenous venography through an inflated balloon catheter
(A) Before BRTO. The venography (left-anterior oblique projection) shows contrast medium occupying a dilated shunt and small collateral vessels of sigmoid- (arrow) and retroperitoneal veins (arrowhead) draining into IVC.
(B) One day post-BRTO. The venography (antero-posterior projection) shows complete occlusion of the IMV-IVC shunt. Arrows indicate metallic coils.

Gifu, Japan) into the distal portion of the shunt through an 8-F-long sheath placed at the orifice via a right jugular vein. Retrograde transvenous venography during balloon occlusion (Fig. 2A) showed contrast medium in the dilated shunt and in small collateral vessels of sigmoid- and retroperitoneal veins draining into the IVC. Firstly, we placed six 18-mm diameter interlocking detachable microcoils (Boston Scientific, Cork, Ireland) and five 8-mm diameter Micronester pushable coils (Cook, Bloomington, Indiana) in the variceal portion of the shunt using a 2.3-F microcatheter (Renegade; Boston Scientific, Cork, Ireland) in order to reduce the total amount of 5% ethanolamine oleate (Oldamin; Takeda Pharmaceutical, Osaka, Japan) iopamidol (Iopamiron 300; Bayer HealthCare, Osaka, Japan) (EOI) delivered as a sclerosing agent. Secondly, we injected 10 ml of 50% glucose solution from the coiling site. Thirdly, under fluoroscopic guidance, we slowly injected 5 ml of EOI through the microcatheter placed at the coiling site to fill in the variceal portion of the shunt, and then confirmed that EOI stayed in the variceal portion. During the procedures the 5F balloon catheter was inflated. The systemic infusion of 4000 units of haptoglobin was started just before the injection of EOI to avoid EOI-induced hemoglobinuria. The patient spent the night with the inflated balloon catheter in place. Retrograde venography through the balloon catheter (Fig. 2B), performed the next day, revealed complete occlusion of the shunt and the entire catheter system was withdrawn.

We encountered no complications during or after the procedure. The patient's blood ammonia level decreased to 29 μg/dL and his clinical symptoms related to hepatic encephalopathy disappeared immediately after the procedure. Contrast-enhanced CT performed 5 days after the procedure showed that the entire shunt was completely thrombosed between the inlet from the splenic vein and outlet into the IVC. His liver function reserve was stable and the patient was discharged 8 days after undergoing the procedure.

CT scans acquired 5 months and 1 year post-treatment (Fig. 1B) confirmed complete disappearance of the shunt, an increase in the size of the main trunk of the portal vein (maximum diameter, 10 mm), and a newly-developed marginal draining vein from the descending and sigmoid colon into the proximal portion of the splenic vein. They also revealed that the volume of the entire liver had enlarged slightly compared to that before BRTO. Both scans were free of evidence of other portosystemic shunts (eg, gastroesophageal varices). In the course of a 20-months follow-up his blood ammonia level remained in the normal range and his liver function was almost stable (Table 1). He no longer manifested any clinical symptoms related to encephalopathy.

DISCUSSION

Different techniques have been used in BRTO procedures[3,7,9,10] and questions such as what portion of the shunt, e.g. the varices-[4,10], the entire-[3], or the distal portion of the shunt[7], should be opacified by sclerosing agents such as EOI, remain to be answered unequivocally.

EOI is widely used in Japan as a sclerosing agent in BRTO procedures. It may lead to venous wall damage and thrombus formation. EOI produces hemolysis in blood vessels resulting in free hemoglobin which may induce renal tubular disturbance and renal insufficiency. As the injection of EOI produces hemoglobinuria[2], haptoglobin should be delivered by intravenous drip infusion just before the injection of EOI. The migration of thrombus into the lungs raises the risk for pulmonary embolism, which may be fatal[8]. Therefore, we suggest that the amount of EOI injected should be as small as possible.

Tanaka et al[10] and Ibukuro et al[4] who successfully treated 2 patients with encephalopathy due to IMV-IVC shunts, injected 20- and 17 ml EOI, respectively, to fill only the variceal portion of the shunts. They suggested that the variceal portion is the portion that should be occluded. We agree with their suggestion and injected 5 ml of EOI to fill the variceal portion of the shunt after introducing the metallic coils. On CT scans obtained 5 days after the procedure we observed thrombus formation involving the entire shunt and the disappearance of inflow from the splenic vein into the IMV.

To prevent the migration of EOI into the main trunk of the portal vein, Hayashi et al[3] injected 40 ml of EOI to fill the entire shunt after placing

Table 1. Laboratory data of the patient before and after BRTO

Laboratory measurement	Before BRTO	After BRTO					
		1 week	1 month	5 months	12 months	15 months	20 months
Ammonia level (g/dL)	175	29	15	18	13	21	9
Serum albumin level (g/dL)	3.7	3.4	3.8	4.2	4.3	4.0	4.2
Total bilirubin level (mg/dL)	1.1	0.8	0.9	0.8	0.7	0.6	0.6
Prothrombin time (%)	85	94	99	86	102	93	98

BRTO, Balloon-occluded retrograde transvenous obliteration.

metallic coils in the shunt inlet from the splenic vein. They reported that a smaller amount of EOI would have been sufficient for shunt occlusion.

Ibukuro et al[4] proposed that, even if EOI spreads toward the main trunk of the IMV, venous congestion is not inevitable because the marginal vein is located medially along the descending colon. In fact, Hayashi et al[3] encountered no complications even after complete occlusion of the entire shunt. Katamura et al[6] reported extensive thrombus formation in the main trunk of the SMV after BRTO for a SMV-IVC shunt; their patient suffered no symptoms associated with thrombosis and they observed hepatopetal blood flow from the IMV via collateral communications between the SMV and IMV.

In our patient only the dilated portion of the shunt was opacified by EOI; the entire shunt was thrombosed 5 days after BRTO and disappeared 5 months later. We noticed the concurrent appearance of a dilated marginal draining vein from the descending and sigmoid colon, an observation also made by Tanaka et al[10]. Matsumoto et al[7] used the transcaval approach to occlude only the draining part of the IMV-IVC shunt with metallic coils in their 4 patients. All patients manifested improvements in the symptoms of encephalopathy. One patient developed a thrombus in the main trunk of the IMV although only the draining part had been embolized and manifested mild congestive changes in the small bowel mesentery.

Opacification of the entire shunt by EOI may not be necessary and occlusion of a portion of the shunt may produce a good outcome. Although a few patients may develop venous congestion, normal return via the tributaries can be expected. We suggest that the injection of lower amounts of EOI is desirable to preserve the normal return and to avoid hemoglobinuria and pulmonary embolism. To reduce the blood outflow, we placed metallic coils in the dilated portion of the IMV-IVC shunt prior to injecting 5 ml of EOI. However, if only the caudal portion of the shunt is completely occluded by coils and there are undetected small collateral channels to the systemic vein through the cephalad end of the introduced coils, collateral channels may develop and re-treatment is difficult. Therefore, if the procedure involves the placement of metallic coils and the injection of EOI, it may be advisable to leave a space in the shunt for catheter negotiation into the cranial portion after coil placement. In our patient we did not stop the flow of blood completely, rather, we reduced the flow by incomplete coil embolization and then injected EOI for opacification around the coils in order to obliterate the dilated portion.

Recently, Boixadera et al[1] reported a case of successful occlusion of a SMV-IMV shunt using an Amplatzer Vascular Plug (AVP), which is not available in Japan. The advantage of the AVP is that it can be more precisely placed in a shorter time than metallic coil and repositioned or removed if necessary. Furthermore AVP can occlude the larger size of vessel. They placed the AVP in the outlet of the shunt. We hope that AVP will become available in our country.

The obliteration of portosystemic shunts produces a change in liver function. In patients with liver function reserve, obliteration may improve liver function. However, if liver function impairment is too severe for reversal, the increase in portal venous flow may produce ascites and gastroesophageal varices[2]. In patients at risk for these complications, portal pressure measurements[7] or arterial portography[4,6] before and after temporary balloon occlusion of the shunt are recommended to test their tolerance for subsequent shunt occlusion. We considered our patient at low risk for such complications because his liver function reserve was relatively preserved. In the course of 20-months follow-up we confirmed an increase in the size of the main portal vein and the volume of the liver and the preservation of his liver function reserve.

In conclusion, we performed BRTO to treat a direct IMV-IVC shunt in a patient with hepatic encephalopathy and achieved complete obliteration of the shunt, the disappearance of his encephalopathy-related symptoms, the slight enlargement of the liver, and the preservation of liver function. Studies on large patient populations using different BRTO techniques are necessary to identify the best BRTO methods.

(Received January 12, 2011)
(Accepted April 4, 2011)

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