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Case Report

Preloading Coil in Plug Method (p-CIP) with the AVP 2 for large Portosystemic Shunt Embolization

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ABSTRACT

Hepatic encephalopathy caused by a large portosystemic shunt (PSS) can be treated by endovascular embolization of the shunt. The PSS diameter can be >20 mm; it occasionally poses technical difficulties. Here, a 72-year-old woman with liver cirrhosis, hyperammonemia, and large spleno-renal shunt underwent shunt embolization using an Amplatzer vascular plug 2 (AVP2) and metallic coils. The preloading coil in plug method (p-CIP), which facilitated embolization inside the AVP2 without cannulation from outside, was employed to overcome technical difficulties. We propose the use of p-CIP with an AVP2 as a tool for treatment of hepatic encephalopathy with PSS.

Introduction

Portosystemic shunt (PSS) develops usually because of portal hypertension and often exhibits increasing diameter, causing intractable hepatic encephalopathy [1]. Although hepatic encephalopathy is treatable by PSS embolization, it is sometimes difficult to occlude the shunt with a balloon catheter or to perform embolization with available embolics (e.g., metallic coils).

Recently, the coil in plug (CIP) method using an Amplatzer vascular plug [1] (AVP1; Abbott Vascular, Redwood City) and metallic coils was reported to be useful in short-length embolization. AVPs are constructed using a box-like embolic material, which comprises nitinol mesh. Although an AVP alone is generally sufficient for vessel embolization, AVPs can recanalize in some instances. CIP is a technique in which an AVP [1] is cannulated with a microcatheter and embolized with metallic coils inside. Using this technique, surgeons can securely embolize vessels and possibly prevent recanalization [2–5]. Notably, the CIP method requires cannulation inside the plug after deployment, which involves uncertainty. To overcome this problem, the preloading coil in plug method (p-CIP) [4] has been developed. In this context, "preloading" indicates that the AVP is penetrated with a microcatheter before deployment. This method facilitates cannulation inside the plug by

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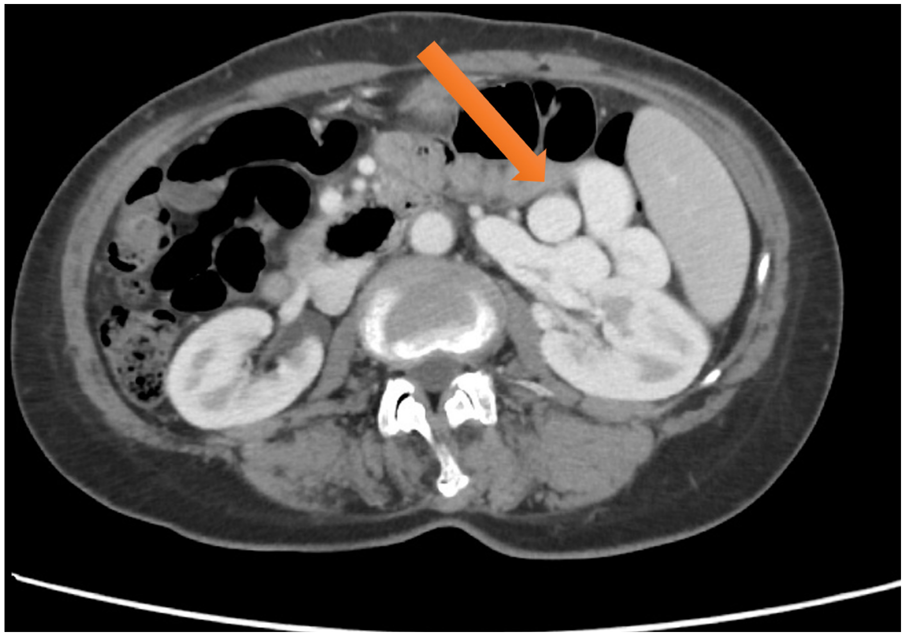

Fig. 1 – Axial image of pretreatment contrast-enhanced computed tomography (CT) showing large diameter spleno-renal shunt (arrow).

catheter withdrawal alone. The maximum AVP [1] diameter is 16 mm, which is insufficient for treatment of a large PSS. An AVP2 can have a larger diameter, compared with an AVP1 (up to 22 mm). Thus far, an AVP2 has not been used for this method. Hence, we performed the p-CIP with an AVP2 to embolize a large diameter PSS.

Case report

A 72-year-old woman with liver cirrhosis was treated conservatively for varying degrees of hyperammonemia (up to 184 μg/dl) for several years. Contrast-enhanced computed tomography showed a 20-mm-diameter spleno-renal shunt (SRS) (Fig 1,2). Therefore, retrograde transvenous embolization of the SRS was planned. Written informed consent was obtained from the patient for the treatment procedure and possible future publication of the findings in this case.

Technique

The right femoral vein was accessed with two vascular sheaths: a five-French standard sheath and a 10-French sheath (ASATO; Medikit, Tokyo). Wedged hepatic vein pressure (WHVP) was continuously monitored for changes in portal vein pressure. The right femoral artery was accessed with a four-French sheath; superior mesenteric artery (SMA) - portography revealed simultaneous hepatopetal flow and hepatofugal flow into the splenic vein and SRS (Fig. 3-A, B). The left renal vein was cannulated with an ASATO sheath, and a 10-French CANDIS catheter (Medikit) was inserted to the SRS. The catheter had a 20-mm balloon at the tip, which successfully occluded the shunt (Fig. 3-C). Following shunt occlusion, the WHVP increased from 11 mmHg to 18 mmHg.

To prepare for p-CIP [4], an AVP2 (22 mm) was exposed from its tapered loader and penetrated with a 17-gauge needle using a plastic cannula from its distal side (Fig. 4-A). Through the tapered loader and the cannula, a 2.2-French catheter (Coiling Support; HI-LEX Corporation, Takarazuka) was advanced with a 0.016-inch guidewire (SUCCEDO; Boston Scientific, Watertown). Thus, the catheter and wire penetrated the AVP2 (Fig. 4-B). Following cannula removal, the catheter and AVP2 were simultaneously retracted into the loader. The prepared AVP [2] was deployed into the shunt through a ^{7}-French shuttle sheath (Fig. 3-D). 5 minutes later, the venous phase of splenic arteriography revealed residual shunt flow through the AVP; therefore, embolization was conducted inside the AVP. The 2.2-French catheter was retracted into the AVP, and 13 detachable coils (total length: 200 cm) (IDC; Boston Scientific) were inserted into the AVP. During embolization, the WHVP gradually increased to 17 mmHg, suggesting shunt occlusion, which was confirmed with splenic arteriography and SMA portography (Fig. 3-E, F). Subsequently, the AVP2 was detached. Contrast-enhanced computed tomography performed 10 months after the procedure revealed shunt occlusion and normalization of the serum ammonia concentration (17 μg/dl). No new-onset ascites or esophageal varix were evident.

Fig 2 – Volume rendering of pretreatment contrast-enhanced CT. Thick green: left renal vein and gonadal vein. Thin green: spleno-renal shunt.(Color version of figure is available online.)

Discussion

The CIP method enhances the advantage of the AVP device and enables embolization of large-bore vasculature over a short length. Usually, metallic coils or liquid embolics require sufficient space or length for vessel occlusion. For example, coils require embolization length of at least [2–3]-fold greater than the diameter because coils form a figure-eight shape, rather than a circle or sphere shape. The advantages of short length embolization include tight embolization, less embolic material, and an ability to satisfy anatomical requirements (e.g., preservation of important side branches). Additionally, CIP helps avoid possible AVP recanalization [6]. Although the AVP2 has the largest diameter in the AVP family, it is difficult to cannulate a main central component because of the disk-shaped peripheral component on both sides of the plug. However, p-CIP enables use of this method when an AVP2 is employed.

As indicated in this report, SRS may be treated with balloon-occluded retrograde transvenous obliteration (BRTO) [7] or coil-assisted retrograde transvenous obliteration (CARTO) [8]. BRTO is a well-established treatment for gastric varix that uses a balloon catheter to occlude the shunt, followed by injection of sclerosant or gelatin sponge slurry to achieve vessel obliteration. CARTO employs metallic coils to occlude the shunt, rather than the balloon catheter. Both BRTO and CARTO are suitable for varix obliteration because it is easy to inject embolic materials from a downstream location without catheter insertion deep into the varix lumen. However, liquid embolic materials (e.g., sclerosant or gelatin sponge slurry) have the potential for spillage into systemic circulation, which may lead to pulmonary embolism [9]. Because it does not employ liquid embolic material, p-CIP is therefore preferable to BRTO and CARTO.

This method has limitations. First, to achieve coiling through the mesh, the microcatheter should be sufficiently robust to maintain its inner lumen. Second, the angle between the axis of the plug and the catheter (as well as the angle between the axis of the plug and the sheath) should be straight to secure the catheter position during coiling. In our patient, the angle between the catheter tip inside the plug and the shuttle sheath became almost right-angled when the sheath was retracted slightly; thus, support from the catheter became weaker during the coiling maneuver. Moreover, catheter re-positioning was impossible. Third, the size of AVP2 used was smaller than recommended range. According to the manufacturer, the suitable device diameter range is approximately 30%–50% greater than the original occlusion site diameter, while the maximum AVP2 diameter is 22 mm.

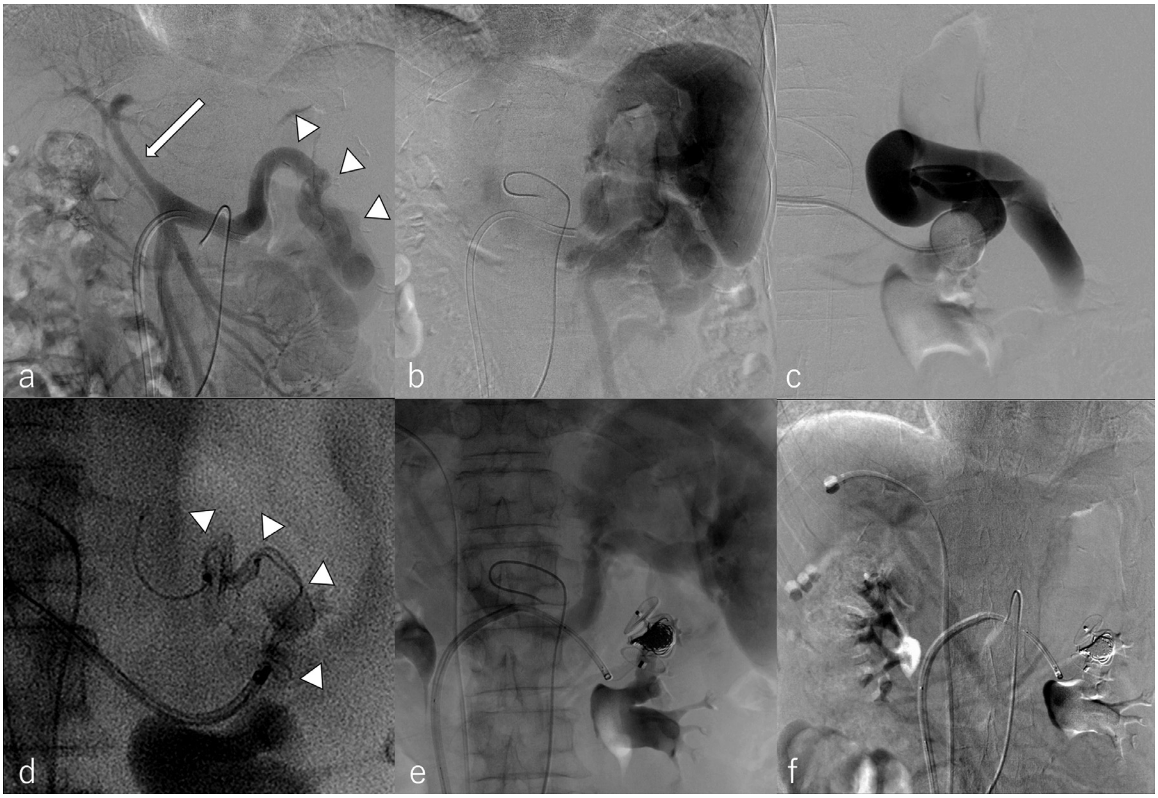

Fig 3 – (A) Superior mesenteric artery (SMA) - portography showing a large portosystemic shunt (arrowheads). The main portal vein (arrow) was comparatively smaller than the splenic vein. (B) Splenic arteriography showing the entire aspect of the shunt. (C) Retrograde venography with balloon occlusion (CANDIS catheter) showing the shunt exit. (D) Deployment of the microcatheter through the AVP2. Note the presence of catheter bending (arrowhead) through the mesh. (E) Venous phase of splenic arteriography after coil occlusion inside the AVP2. Note that the shunt completely disappeared. (F) SMA portography after shunt occlusion showing disappearance of retrograde flow in the splenic vein.

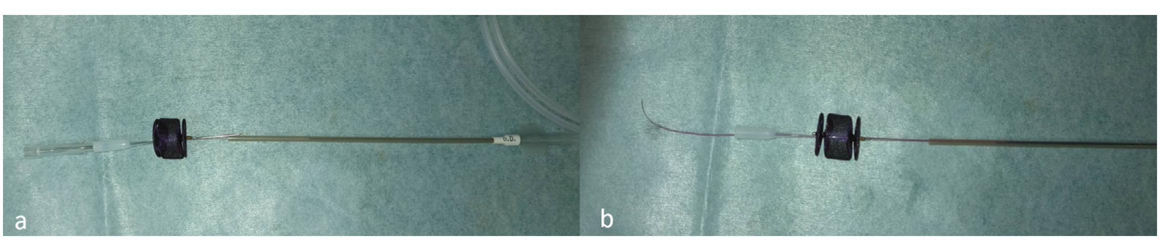

Fig. 4 – (A) The AVP2 was penetrated with a 17-gauge needle and a cannula from its distal side. (B) A microcatheter with a guidewire was inserted into the outer cannula through the tapered loader. Subsequently, the cannula was removed; the catheter and plug were simultaneously retracted into the loader.

In conclusion, p-CIP with an AVP2 was useful for embolization of a large-diameter SRS. To our knowledge, this is the first report of p-CIP application in a venous system. Although the AVP2 size may be suboptimal for a large SRS, shunt occlusion and hyperammonemia improvement were both achieved in this case.

Compliance with Ethical Standards

Research involving Human Participants and/or Animals

The requirement for obtaining approval of the ethics committee was waived for this procedure because all devices used were approved for endovascular treatment.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

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Patient Consent

The patient treated in this case report has been informed about the treatment and possible future publication. The patient has given to us a written consent.

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