Vascular Plug-Assisted Retrograde Obliteration (PARTO) of Right Mesorenal Shunt for Hepatic Encephalopathy: An Uncommon Site of a Spontaneous Portosystemic Shunt in Cirrhosis

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Indian J Radiol Imaging 2023;33:571–573.

A 47-year-old male patient with alcohol-related cirrhosis presented to the liver clinic with the complaint of repeated episodes of hepatic encephalopathy (HE) manifested as a disturbance in sleep pattern, hypersomnia, impaired memory, mental confusion, and drowsiness (West Haven grade II/III). On evaluation, the patient had a Child-Pugh score of 6 (CTP-A), hyperammonemia (>200 µg/dL), small and low-risk esophageal varices, splenomegaly, and a large right mesorenal shunt (MRS) with afferent from the superior mesenteric vein and draining into the right renal vein (►**Fig. 1**). Vascular plug-assisted retrograde transvenous obliteration (PARTO) of the right MRS was planned since HE and hyperammonemia persisted despite the optimization of standard medical treatment.

PARTO was performed in the digital subtraction angiography suite through the right femoral approach. Reviewing the computed tomography (CT) portogram helped localize the efferent vein draining into the superior wall of the right renal vein near inferior vena cava. A 4Fr Simmons 1 (SIM1) glide catheter (RADIFOCUS Glidecath; Terumo Interventional System, Somerset, NJ) was used to cannulate the efferent vein. Venogram demonstrated the shunt anatomy and flow dynamics. The 4F glide catheter was advanced deep into the shunt over the hydrophilic guide wire. Over a stiff guidewire, a 10Fr long sheath was advanced into the efferent vein of the MRS. This is the rate-limiting step in PARTO. With sheath in place, a 2.7 Fr microcatheter (Progreat, Terumo Interventional System; Somerset, NJ) was advanced coaxially deep into the shunt (►**Fig. 2A–E**).

Oversizing by 45%, a 16 mm vascular plug (Cera Vascular Plug, Lifetech) was deployed at the narrowest part of the efferent vein (11 mm) near its communication with the right renal vein. A venogram was performed to check the flow dynamics of the shunt after the plug deployment. Initially, the shunt was embolized using 4 mL of Gelfoam solution to achieve stasis of flow across the plug. Furthermore, embolization was done with a 06 mL mixture of 3% sodium tetradecyl sulfate, lipiodol, and air (1:2:3) (►**Fig. 2F–H**). No periprocedural complication was observed.

The patient had significant clinical improvement following 2 weeks of the procedure. No further recurrence of HE was observed until the last follow-up at 2 months. Follow-up contrast-enhanced CT revealed a thrombosed right MRS with an increase in portal vein diameter, indicating increased portal flow (►**Fig. 3**). Venous ammonia levels were reduced to 73 and 54 µg/dL at 2 weeks and 2 months of PARTO.

Right MRS is a rare type among spontaneous postosystemic shunts (SPSSs). Large SPSS (>8 mm in caliber) in cirrhosis may cause recurrent and refractory HE, negatively influencing the quality of life and survival. Endovascular obliteration of SPSS improves HE and the portal flow, thereby increasing the synthetic hepatic function in cirrhotic and post-transplant patients.[1–3]

PARTO is a well-established technique that utilizes a vascular plug to occlude the efferent vein. Reviewing the pre-procedure contrast-enhanced CT or magnetic resonance imaging helps decide the best approach for selecting the shunt.[4] In case of difficult hooking of a shunt, a reversed-shaped catheter, such as SIM1, may provide easier and more stable access.[5] Shunt occlusion requires procedural modification depending on the venous drainage pattern and

article published online
May 18, 2023

DOI https://doi.org/10.1055/s-0043-1768963.
ISSN 0971-3026.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

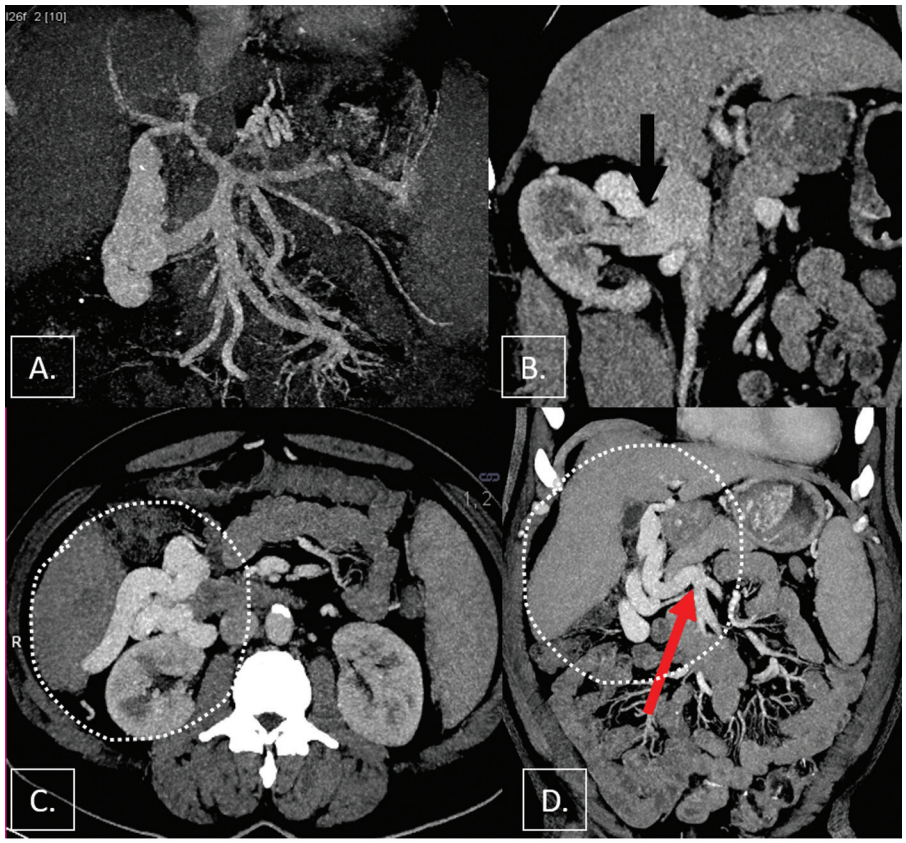

Fig. 1 Thick coronal maximum intensity projection (MIP) image (**A**) shows right-sided mesorenal shunt; (**B**) coronal venous phase computed tomography (CT) reveals the efferent vein draining into the right renal vein adjacent to inferior vena cava (black arrow); (**C** and **D**) thick axial and coronal MIP CT images depict dilated and tortuous right mesorenal shunt (white dash circle, **C**, **D**) communicating with superior mesenteric vein (red arrow, **D**).

Fig. 2 Plug-assisted retrograde transvenous obliteration of right mesorenal shunt. (**A**) Right renal vein was cannulated using a 5F renal double curve catheter; (**B**) a Simmon1 (SIM1) catheter hooked efferent vein; (**C**) SIM1 catheter (white arrow) was advanced deep into the mesorenal shunt; (**D**) a 10F vascular sheath (arrowhead) was advanced into the efferent vein over a stiff guidewire; (**E**) venogram through a 2.7F microcatheter keeping ahead of the vascular sheath into the shunt delineated the shunt anatomy (dotted arrow) and flow dynamics; (**F**, **G**) a 16mm vascular plug was deployed at the narrowest part of the efferent vein. The shunt was initially embolized using Gelfoam solution, followed by embolized with lipiodol, 3% sodium tetradecyl sulfate, and air mixture; (**H**) spot fluoroscopy shows embolic cast within the mesorenal shunt.

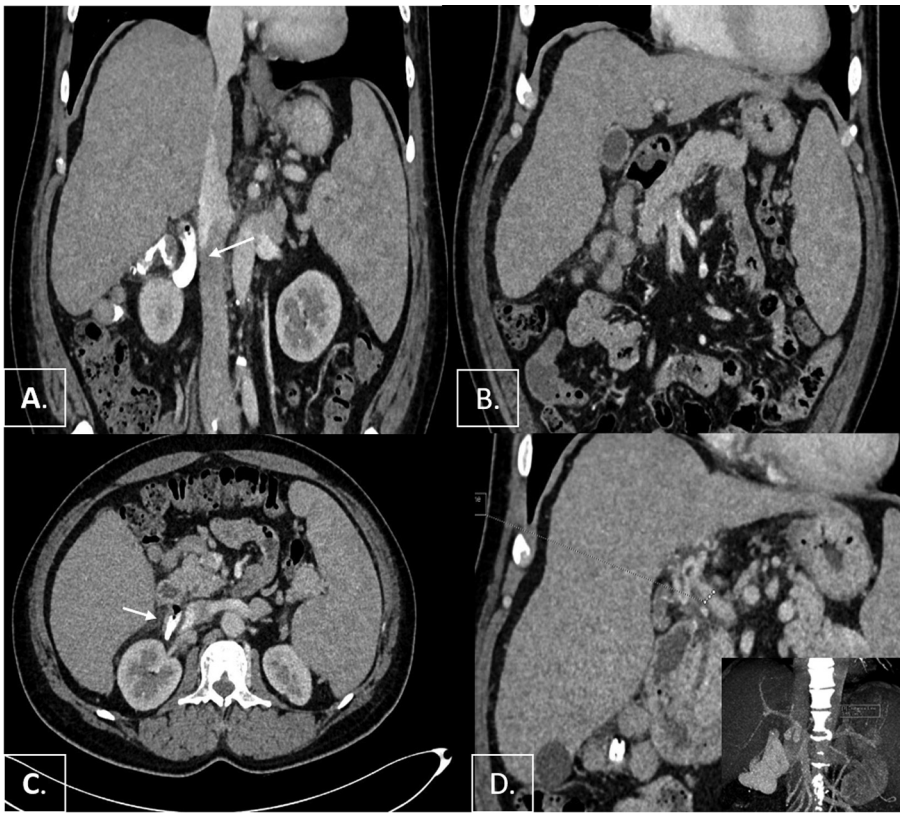

Fig. 3 (**A**–**C**) Post-plug-assisted retrograde transvenous obliteration contrast-enhanced computed tomography (CT) images demonstrate the vascular plug and lipiodol cast (white arrow, **A**, **C**) in situ with thrombosed right mesorenal shunt (**B**). Coronal CT image (**D**) shows a relative increase in the diameter of the portal vein (9.5mm) in comparison to the pre-procedure diameter (5 mm) (inset coronal image, **D**).

afferent vein anatomy. Our patient had a type A (single draining vein) shunt; thus, occlusion of the draining vein near the right renal vein using a vascular plug sufficed.[5] Cone-beam CT, whenever available, allows for documentation of the filling of varix with sclerosant and helps to decide the end point of embolization.[5,6]

Of note, shunt occlusion worsens portal hypertension and may lead to aggravation of esophageal varices and ascites formation. In addition, shunt occlusion may cause portal vein thrombosis at times.[1,2]

This letter illustrates a right-sided MRS, which is rare among SPSSs. With the aid of pre-procedural imaging, PARTO seems to be a viable option to treat shunt-related HE. Appropriate patient selection is critical to prevent post-procedural complications.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

None.

Conflict of Interest

None declared.

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