Utility of Detachable Coils in Renal and Splenic Artery Aneurysms and Gastric Artery Pre-Radioembolization

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Embolization is essential to the treatment of various pathologies, including aneurysms, traumatic hemorrhage, arteriovenous malformations, gastrointestinal hemorrhage, endoleaks, varicoceles, and pelvic congestion syndrome. Embolization of the gastroduodenal artery and right gastric artery is considered the standard of care prior to yttrium-90 radioembolization. An ideal embolic agent is flexible, stable, trackable, repositionable, cost-effective, and allows for precise deployment and rapid vascular occlusion. The Interlock™ Fibered IDC™ Occlusion System meets these characteristics and is approved for use in the peripheral vasculature. The following cases demonstrate the clinical utility of these detachable coils.

CASE 1: RENAL ARTERY ANEURYSM

Overview

A 54-year-old woman with a history of fibromuscular dysplasia was found to have bilateral renal artery aneurysms. The patient presented for treatment of a 2.2-cm left renal artery aneurysm arising from the hilum.

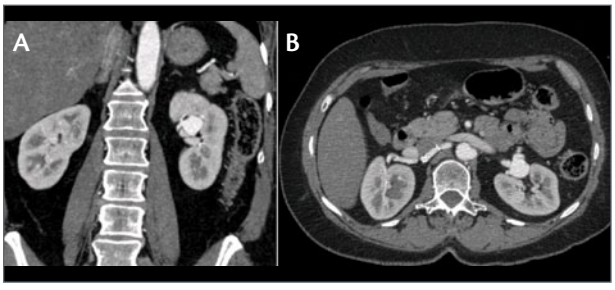

Figure 1. Coronal (A) and axial (B) images showing a complex aneurysm, measuring approximately 2.2 cm and arising from the left renal hilum. There were several outflow vessels arising from the aneurysm. A right renal stent and right renal aneurysm, both incompletely visualized, were also noted.

Computed tomography (CT) angiography showed that the aneurysm was complex, involving a single inflow but multiple outflow vessels (Figure 1).

Procedure Description

A 9-F sheath was placed in the right common femoral artery, and a robotic catheter was used in conjunction with a 0.035-inch hydrophilic guidewire to catheterize the left renal artery (Figure 2). A left renal angiogram showed classic beading of the main left renal artery, consistent with the known history of fibromuscular dysplasia as well as a saccular aneurysm in the distal left renal artery near the hilum with several arterial branches emanating from the aneurysm sac (Figure 3).

After rotational angiography to better define the arterial anatomy, two 18-mm X 40-cm Interlock™ Coils were advanced under fluoroscopic guidance into the aneurysm sac. A final 15-mm X 40-cm Interlock™ Coil was deployed within the aneurysm sac (Figure 4). Intermittent angiography was performed between coils to ensure that the coils did not occlude the outflow vessels. The

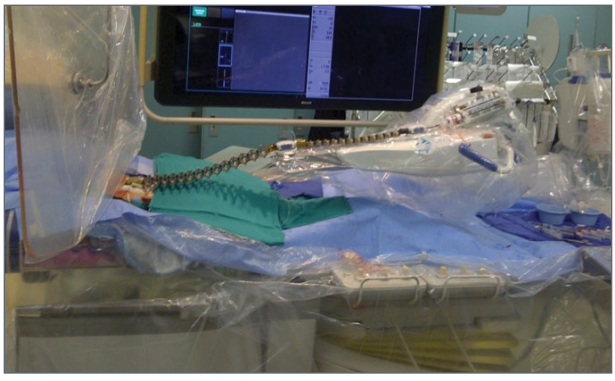

Figure 2. A robotic catheter was used to catheterize the left renal artery.

Results from case studies are not necessarily predictive of results in other cases. Results in other cases may vary.

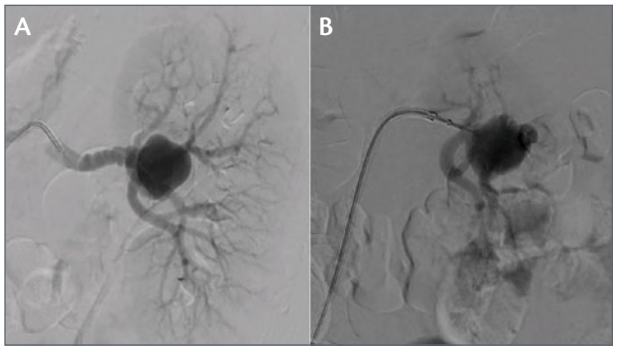

Figure 3. There is a classic beaded appearance of the main left renal artery compatible with fibromuscular dysplasia (A). Several arteries emanating from the aneurysm sac were also noted (B).

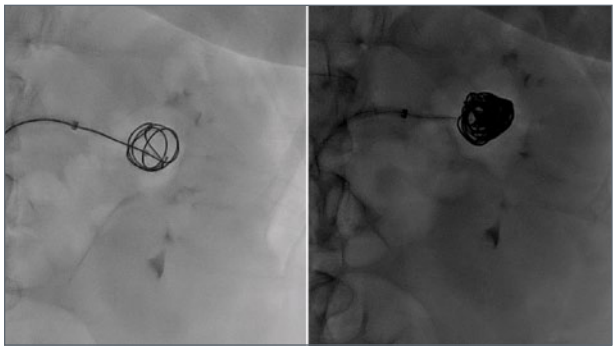

Figure 4. Coil embolization was performed with Interlock™ Coils via the robotic catheter until dense packing was achieved. Repositioning was performed during the procedure to achieve optimal positioning of the coils.

postembolization angiogram showed occlusion of the aneurysm without compromise of the adjacent renal branches (Figure 5). No filling defects or wedge-shaped areas of nonperfusion were identified to suggest renal parenchymal infarct.

Discussion

Renal artery aneurysms have a prevalence of 0.1% and are more frequent in women. Etiologies include fibromuscular dysplasia, atherosclerosis, trauma, and iatrogenic injury. Indications for treatment include patients who are symptomatic (eg, rupture, hypertension, hematuria, pain), women who are pregnant or are of child-bearing age, asymptomatic patients with aneurysms > 2 cm, and aneurysms associated with dissection.

Endovascular treatment of renal and visceral aneurysms has been shown to be safe and effective.[1,2] The detachable aspect of the Interlock™ Coil was critical in this case, as occlusion of adjacent renal branches would have resulted in renal infarction. This characteristic allowed for partial deployment followed by coil withdrawal and repositioning until an optimal coil position was attained. Given the precarious location of the aneurysm, the ability to densely pack the aneurysm with repositioning as necessary was key in achieving a successful outcome.

A recent study by Yasumoto et al demonstrated that inadequate coil packing in visceral aneurysms results in coil compaction and recanalization, underscoring the need to densely pack these aneurysms to achieve long-term success.[3]

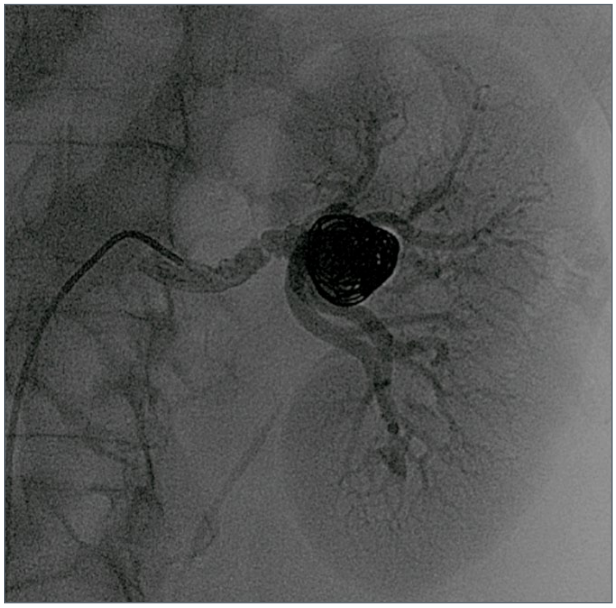

Figure 5. A completion arteriogram showed exclusion of the left renal artery aneurysm and normal opacification of the left renal artery. There were no wedge-shaped areas of nonperfusion identified to suggest renal parenchymal infarct.

CASE 2: SPLENIC ARTERY ANEURYSM WITH DISTAL EMBOLIZATION

Overview

A 49-year-old woman with no significant medical history presented to the emergency room with severe left-sided abdominal pain. Because the patient was allergic to iodine, a noncontrast CT scan of the abdomen was performed, which showed a calcified 2.5-cm splenic artery aneurysm without evidence of rupture (Figure 6A). A subsequent abdominal magnetic resonance imaging scan and magnetic resonance angiogram (Figures 6B and 7) again showed the splenic aneurysm with some luminal

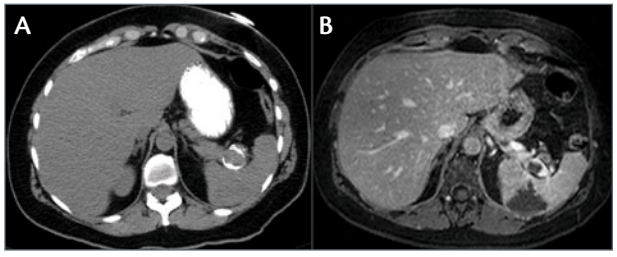

Figure 6. Noncontrast CT scan showing a 2.5-cm calcified distal splenic artery aneurysm with no evidence of hemoperitoneum to suggest rupture (A). A magnetic resonance imaging scan with contrast shows a distal splenic artery aneurysm with intraluminal thrombus and associated wedge-shaped splenic infarction (B).

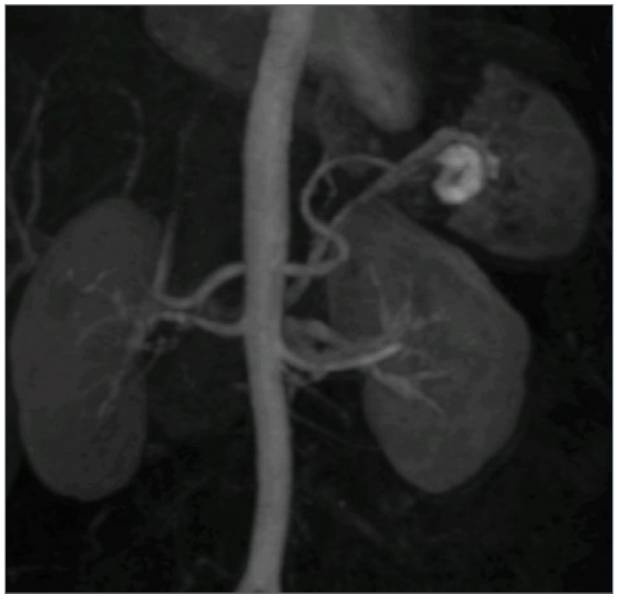

Figure 7. A magnetic resonance angiogram again showing a distal splenic artery aneurysm with some intraluminal thrombus.

thrombus, as well as a wedge-shaped splenic infarction responsible for the patient's abdominal pain.

Procedure Description

After steroid premedication for contrast allergy and administration of pneumococcal vaccine, the right common femoral artery was accessed and a celiac angiogram was obtained with a reverse curved catheter. Figure 8 shows a distal splenic aneurysm arising from the superior branch of the splenic artery. The aneurysm was successfully embolized with three 15-mm X 40-cm Interlock™ Coils, followed by a 6-mm proximal coil (Figure 9). Completion angiography showed complete exclusion of the embolized aneurysm with a small area of nonperfusion to the superior spleen consistent with small infarction (Figure 10).

Figure 8. An angiogram showing a distal splenic aneurysm arising from the superior branch of the splenic artery.

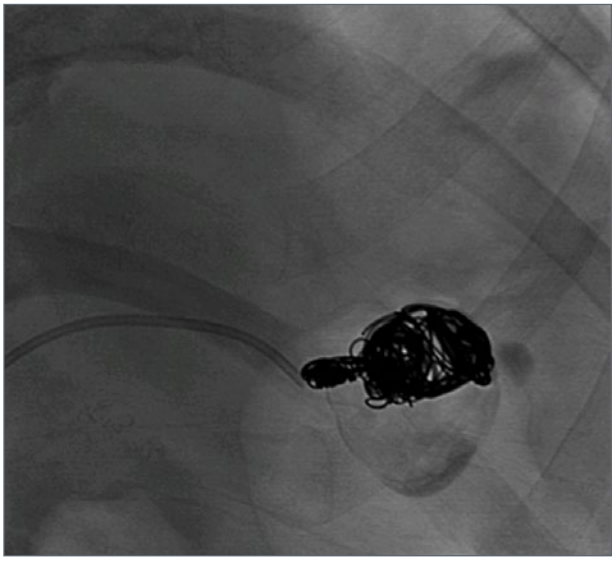

Figure 9. A fluoroscopic image after placement of several Interlock™ Coils.

The patient tolerated the procedure well and developed no procedural complications. She was treated with antibiotics after the procedure to minimize the risk of infection and abscess.

Discussion

Splenic artery aneurysms are the most common type of visceral aneurysms and are more commonly found in women. Predisposing conditions believed to contribute to the development of these aneurysms include

Figure 10. Completion angiogram showing complete exclusion of the embolized aneurysm with a small area of nonperfusion to the superior spleen compatible with small infarction.

medial fibroplasia, pregnancy, and portal hypertension. Splenic pseudoaneuryms are due to pancreatitis, trauma, or infection. Approximately 2% of bland splenic aneurysms rupture; however, when rupture occurs, the mortality rate is high, especially in patients who are pregnant.

Patients may be symptomatic from rupture or as a result of distal embolization from intraluminal thrombus formation, as in our patient. Indications for therapy include patients who are symptomatic, women who are pregnant or may become pregnant, patients with portal hypertension or status post liver transplantation, and asymptomatic patients with aneurysms > 2 cm. Pseudoaneurysms of any size should be treated.

The long length of the Interlock™ Coils (40 cm) resulted in rapid aneurysm exclusion and necessitated fewer coils than would be required with shorter, pushable coils. The synthetic fibers embedded on these coils also contribute to the system's thrombogenicity, decreasing the time to achieve vascular occlusion. An additional benefit of the Interlock™ Coil delivery system is its ease of use. In contrast to many other detachable coils, which require a special deployment device, the Interlock™ Coil is simply released by pushing the coil beyond the microcatheter. The coil and pusher have interlocking mechanical arms. As long as the operator maintains the mechanical interlocking arms of the coil within the microcatheter, the coil can be retracted for repositioning.

CASE 3: PRE-YTTRIUM 90 EMBOLIZATION OF GASTRODUODENAL ARTERY AND RIGHT GASTRIC ARTERY

Overview

A 66-year-old man with a history of hepatitis C and cirrhosis presented with multifocal hepatocellular carcinoma. A decision was made to perform yttrium-90 radioembolization to help control his disease. The patient had intermediate stage B disease per the Barcelona Clinic Liver Cancer Staging system and had a preserved performance status. Of note, his liver function tests were within normal limits and the portal vein was patent.

Procedure Description

A 5-F vascular sheath was placed via the right common femoral artery, and a celiac angiogram was obtained with a 5-F Cobra-2 catheter (Figure 11). Several hypervascular masses were identified in the right and left hepatic lobes. A typical gastroduodenal artery (GDA) and a small right gastric artery arising just distal to the GDA were also noted. Using a Fathom®-16 Steerable Guidewire, the right gastric artery was selected with a 2.8-F Direxion HI-FLO™ Microcatheter and a selective angiogram was obtained (Figure 12). The right gastric artery was then embolized with a 3-mm X 12-cm Interlock™ Coil, and the GDA was subsequently selected and embolized with 5-mm X 15-cm and 4-mm X 15-cm Interlock™ Coils. Common hepatic angiography after embolization showed successful occlusion of these vessels (Figure 13).

Figure 11. Celiac angiogram showing multiple bilobar hypervascular masses in the liver. A typical GDA and a small right gastric artery arising just distal to the GDA were also noted.

Discussion

After embolization, Tc-MAA administered into the proper hepatic artery demonstrated no significant pulmonary or extra-hepatic shunting, and the patient underwent uncomplicated radioembolization of the right hepatic lobe

Figure 12. A selective right gastric angiogram via a Direxion HI-FLO™ Torqueable Microcatheter.

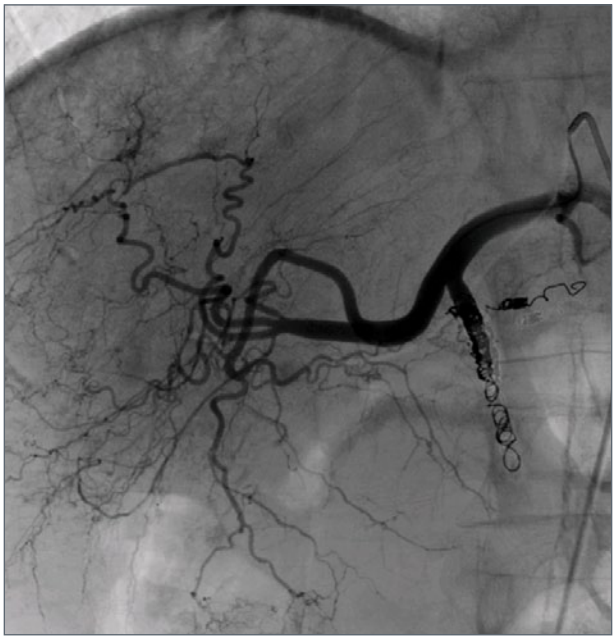

Figure 13. Postembolization common hepatic angiogram showing successful occlusion of the GDA and right gastric artery with Interlock™ Coils.

followed by the left hepatic lobe. His hepatocellular carcinoma was stabilized with this treatment.

The Interlock™ Coils were placed rapidly and effectively with precision, potentially decreasing procedure time and radiation exposure. The ability to precisely control the deployment of the Interlock™ Coils is specifically advantageous in these procedures should the coil be undersized or oversized for the given vessel, allowing for repositioning and precluding non-target embolization.

The Bern-shape Direxion HI-FLO™ Microcatheter used in this case has a unique shaft that allows for unrivaled torqueability compared to any other microcatheter. During the procedure, there was near 1:1 tip response to hub rotation, which was particularly helpful in catheterizing the challenging right gastric artery in this patient. In addition to its torqueability, the microcatheter demonstrated excellent flexibility and trackability. ■

Ripal T. Gandhi, MD, FSVM, is with Baptist Cardiac and Vascular Institute in Miami, Florida. He has disclosed that he is a consultant to Boston Scientific Corporation and received compensation for the time required to identify, organize, and summarize the case information within the manuscript. Dr. Gandhi may be reached at gandhi@baptisthealth.net.

David Quintana, MD, is with University of Miami Miller School of Medicine in Miami, Florida. Dr. Quintana received no compensation related to this article.

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2. Fankhauser GT, Stone WM, Naidu SG, et al. The minimally invasive management of visceral artery aneurysms and pseudoaneurysms. J Vasc Surg. 2011;53:966-970.
3. Yasumoto T, Osuga K, Yamamoto H, et al. Long-term outcomes of coil packing for visceral aneurysms: correlation between packing density and incidence of coil compaction and recanalization. J Vasc Interv Radiol. 2013;24:1798-1807.