Endovascular stent-graft placement and coil embolization for an anomalous splenic artery aneurysm

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Aneurysms of the splenic artery originating anomalously from the superior mesenteric artery are extremely rare; however, they are clinically important because of the potential for fatal rupture and particular anatomical location. Most previous cases were managed by open surgical intervention. We present a case of an anomalous splenic artery aneurysm, which was successfully treated with endovascular stent graft placement and coil embolization. This appears to be a promising minimally invasive approach to manage this rare entity. Also, we review the literature of aneurysms of the splenic artery arising from the superior mesenteric artery. (J Vasc Surg 2011;54:208-11.)

Aneurysms of the splenic artery (SA) are the most common visceral artery aneurysms.[1] However, aneurysms of the SA with an aberrant origin from the superior mesenteric artery (SMA) are extremely uncommon. To our knowledge, there were only 24 cases reported in the literature.[2-17] These aneurysms are clinically important, because rupture may cause life-threatening hemorrhage. Moreover, their particular anatomical characteristics render their treatment more complex.[10,14,16] Herein, we report a case of an aneurysm of the SA arising from the SMA. This is the first case treated with a combination of endovascular stent graft placement and coil embolization, in which the stent graft was implanted into the SMA.

CASE REPORT

A 67-year-old woman presented with intermittent epigastric pain of 3 months duration. The clinical examination was unremarkable. The patient had a 6-year history of systemic hypertension. No history of abdominal trauma, pancreatitis, or portal hypertension was noted. Results of laboratory tests were normal, including blood cell count, serum amylase, and liver function tests. Gastroscopy did not reveal any intraluminal pathology.

Abdominal ultrasonography showed a 2.1-cm aneurysm behind the pancreas, which was suspected to originate from the SMA. Computed tomographic (CT) angiography demonstrated a saccular aneurysm arising close to the origin of the SA, which originated from the proximal SMA (Fig 1). The proximal aneurysm neck was almost 4 mm in length and 8 mm in diameter. The distance between the two orifices of the SA and SMA was about 2.2 cm. The diameters of the proximal SMA and the distal SA were almost 9 mm and 7 mm, respectively. Given the age, comorbidity, and particular anatomical location, endovascular therapy was considered. Written informed consent was obtained before the procedure.

Endovascular intervention was performed under local anesthesia. The right femoral artery and left brachial artery were punctured percutaneously. Heparin (100 U/kg) was administered intravenously. A 0.035-inch, 150-cm guidewire was introduced via the femoral artery. Then, a 4F Cobra catheter was advanced into the SMA orifice. Selective SMA angiography confirmed an aneurysm of the SA arising from the SMA (Fig 2, *A*). A 9F, 13-cm-long arterial sheath was placed into the brachial artery, and a 5F Vert catheter was introduced into the SMA. Angiography was performed via the Vert catheter in real time. The Cobra catheter was advanced into the distal SA. Three 0.035-inch, 5-cm-long stainless steel coils forming loops with an 8-mm diameter (Cook Inc, Bloomington, Ind) were placed into the distal SA (Fig 2, *B*). Then, the Cobra catheter was retracted and reserved at the SMA orifice.

A 0.035-inch, 260-cm Terumo stiff guidewire (Terumo, Tokyo, Japan) was introduced into the SMA through the Vert catheter. A 10 × 40 mm Fluency covered stent (CR Bard Inc, Murray Hill, NJ) was negotiated over the stiff guidewire. Angiography was performed via the Cobra catheter to locate the stent graft. After the stent graft was located accurately, the Cobra catheter was advanced into the aneurysmal lumen for subsequent embolization. The endograft was then deployed (Fig 2, *C*). No branch of the SMA was covered by the stent graft. The distal landing zone was almost 10 mm. Another three 0.035 inch/5 cm/8 mm coils were placed into the aneurysm sac via the Cobra catheter. Completion angiography showed complete exclusion of the aneurysm with no endoleak (Fig 2, *D*). The brachial artery was manually compressed above the puncture site to maintain hemostasis for almost 15 minutes. Gauze pads and bandages were then applied above the puncture site.

The patient recovered uneventfully without puncture site complications, and was discharged home on postoperative day 3. Clopidogrel, 75 mg/day, was given for 3 months. Aspirin, 100

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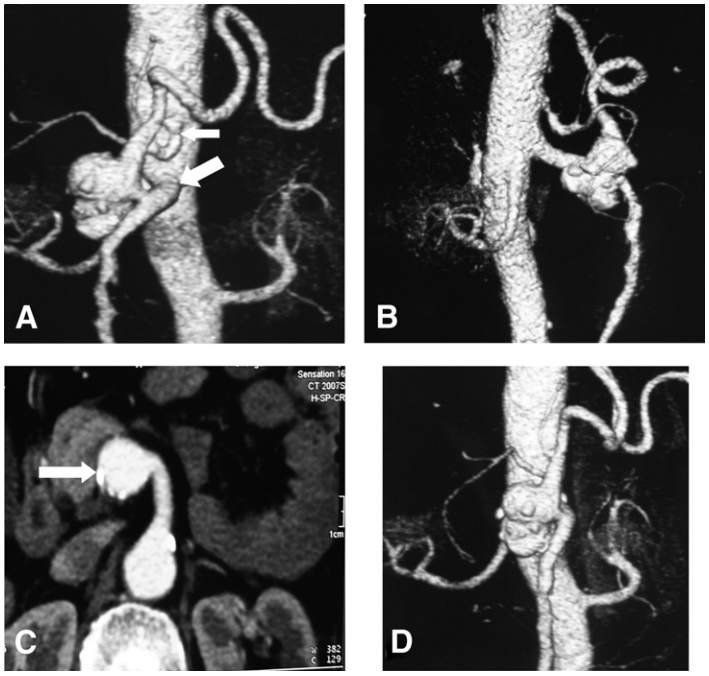

Fig 1. A, **B**, and **D**, Preoperative computed tomographic (CT) images with three-dimensional reconstruction from different positions show a saccular aneurysm arising near to the origin of the splenic artery (SA) which arises from the superior mesenteric artery (SMA) (*large arrow*). The left gastric artery and common hepatic artery arise from the celiac axis (*small arrow*). **C**, CT scan shows a calcified aneurysm (*arrow*) communicating with the SMA.

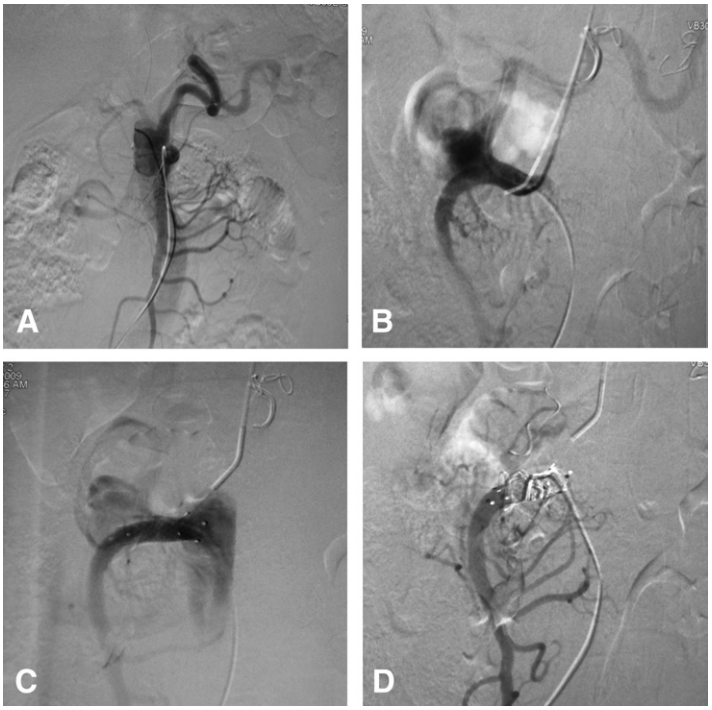

Fig 2. Intraoperative angiograms. **A**, Superior mesenteric artery (SMA) angiogram demonstrates the findings of computed tomography angiography. **B**, Angiogram after coil embolization shows persistent blood flow in the splenic artery (SA). **C**, Aortogram after stent graft placement reveals persistent blood flow within the aneurysm. **D**, Completion angiogram demonstrates complete exclusion of the aneurysm and patency of the SMA.

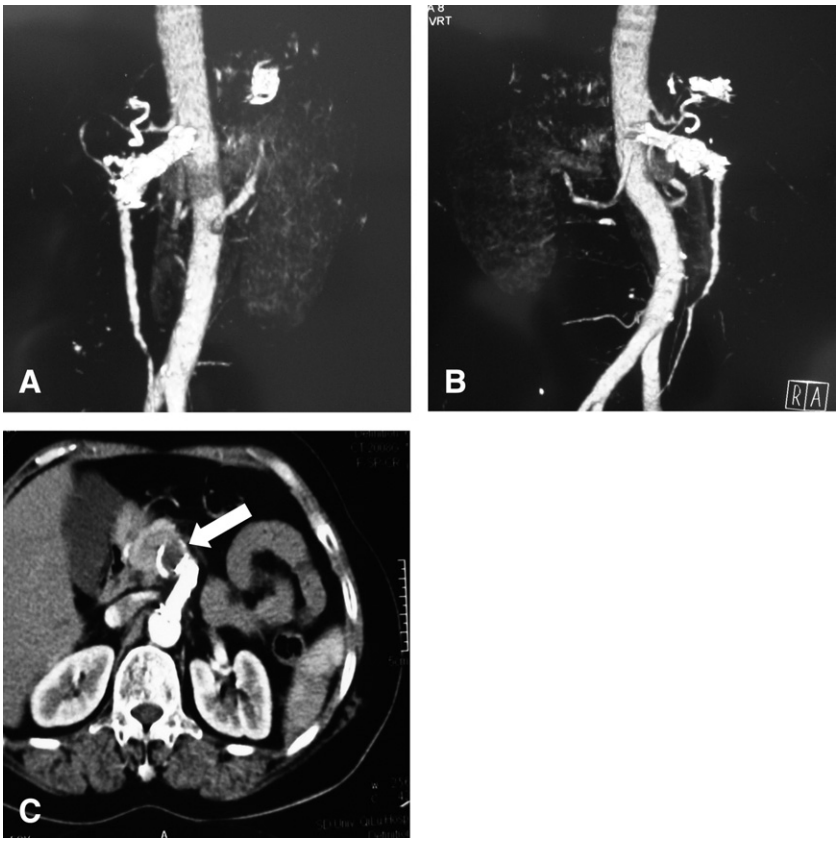

Fig 3. **A** and **B**, Computed tomographic (CT) images with three-dimensional reconstruction at 12-month follow-up show patency of the superior mesenteric artery (SMA), and no aneurysm is identified. **C**, CT scan shows thrombosis within the aneurysm (*arrow*).

mg/day, was taken as a lifelong medication. No discomfort was complained of at 12-month follow-up. CT angiography showed patency of the SMA. No blood flow was identified within the aneurysm or the SA (Fig 3). No evidence of splenic infarction was noted. The patient will be followed by CT angiography annually.

DISCUSSION

The SA arising from the SMA is rare with an incidence of 1%.[5] Aneurysms of the SA arising from the SMA are extremely rare. To date, 24 cases have been reported in the literature.[2-17] Of these 25 cases (including the current case), 18 were female (72%) and seven were male (28%). Mean age was 49.2 ± 12.5 years (range, 29-76 years). Ten cases (40%) were asymptomatic, and epigastric pain was the most common symptom (32%). No ruptured aneurysm was noted. Mean aneurysm size was 3.0 cm (range, 2.0-6.0 cm). Atherosclerosis was the most common result of histologic examination (20%). Interestingly, almost all aneurysms were in a particular location, located at the root of the SA, which originated from the proximal SMA behind the pancreas. The cause remains unknown.

Several therapeutic methods have been used to treat these aneurysms (Table). Compared with open repair, the authors believed endovascular treatment may be safer for the current patient. Coil embolization alone was excluded, because high blood flow within the aneurysm may cause coil migration into the SMA[12-14] and prevent thrombosis.[10] Detachable coils may be safer than nondetachable coils in these high-flow aneurysms, but they are usually expensive.[15] The tortuous SA was angled to the SMA, so it would be difficult to maneuver a rigid stent graft through the SMA and SA.[14] Given backflow of blood from other supplying arteries of the spleen,[8,9,16] we did not select SMA endograft placement alone. Thus, combined stent graft placement and coil embolization was considered most appropriate. In order to prevent endoleak, an additional three coils were placed into the aneurysm sac. These coils were placed after the stent graft was deployed, because it could avoid coil migration into the SMA and facilitate thrombosis.

Compared with open surgery and combined endovascular and laparoscopic techniques, it seems total endovascular treatment is minimally invasive with rapid recovery. Theoretically, a combination of stent graft placement and coil embolization is more appropriate than other endovascular methods for these aneurysms. Patients should be observed postoperatively for potential complications, including splenic infarction or abscess, pancreatitis, and en-

Table. Summary of treatment for anomalous splenic artery aneurysms

Author, year	*Number*	*Treatment*
Ghatan,[2] 1967	1	Aneurysmectomy and splenectomy
Negita,[3] 1992	1	Aneurysmectomy with direct SA to SMA anastomosis (end-to-side)
Sidhu,[4] 1995	1	Aneurysmectomy
Settembrini,[5] 1996	2	Aneurysmectomy and splenectomy Tangential aneurysmectomy
Patel,[6] 1998	1	Aneurysmectomy and reconstruction of the SA with a reversed saphenous vein graft
Feo,[7] 2004	1	Aneurysmectomy with direct SA to SMA anastomosis (end-to-side)
Tochii,[8] 2005	1	Aneurysmectomy
Migliara,[9] 2005	2	Aneurysmectomy Transcatheter embolization with platinum coils
Mastracci,[10] 2005	2	Combined transcatheter embolization with platinum coils and laparoscopic occlusion of the SA
Facy,[11] 2006	1	Ligation
LaBella,[12] 2006	1	Ligation
Sato,[13] 2006	1	Transcatheter embolization with detachable coils
Illuminati,[14] 2007	1	Aneurysmectomy
Tanigawa,[15] 2009	1	Transcatheter embolization with detachable coils
Liu,[16] 2009	6	Endovascular stent graft placement into the SMA Refuse to treatment Transcatheter embolization with gelfoam and glue Aneurysmectomy Endovascular stent graft placement into the SMA Aneurysmectomy and splenectomy
De Cloedt,[17] 2010	1	Aneurysmectomy
The current case	1	Endovascular stent graft placement and embolization with stainless steel coils

SA, Splenic artery; *SMA,* superior mesenteric artery.

doleak. Follow-up is necessary to evaluate the long-term results.

CONCLUSION

We describe the first case of endovascular stent graft placement and coil embolization for an anomalous SA aneurysm. Further studies are needed to determine the applicability and long-term results. However, the authors believe it is a safe, effective, and minimally invasive therapeutic option for these anomalous SA aneurysms.

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