Endovascular exclusion of a saccular aortic aneurysm using a septal occluder device

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Endovascular repair of aneurysms involving the visceral segment of the abdominal aorta still remains a challenge. We report a patient with a large saccular aneurysm involving the visceral segment of the abdominal aorta that was ultimately excluded by endovascular deployment of an Amplatzer atrial septal occluder device (AGA Medical/St. Jude Medical, St Paul, Minn). (J Vasc Surg 2011;53:1097-9.)

Since the introduction of endovascular techniques, repair of thoracic and abdominal aortic aneurysms has evolved from an open to an endovascular approach. The endovascular repair of aneurysmal disease is associated with decreased morbidity in high-risk surgical patients. With the advance in endograft technology, more and more anatomically difficult aneurysms can be repaired through an endovascular approach. Endovascular repair of aneurysms involving the visceral segment of the abdominal aorta still remains a challenge. Progress in technology, with respect to branched and fenestrated graft techniques, will offer additional solutions in the near future to this challenging anatomic configuration.

In the following case report, we present a patient with a 6.5-cm saccular aneurysm involving the visceral segment of the abdominal aorta. After an aborted open repair, the aneurysm was ultimately excluded by an alternate endovascular approach involving the deployment of an Amplatzer (AGA Medical/St. Jude Medical, St. Paul, Minn) atrial septal occluder (ASO) device.

CASE REPORT

A 76-year-old woman was referred to our institution after the incidental discovery of a 6.5-cm saccular abdominal aortic aneurysm after she was involved in a motor vehicle collision (MVC). She had an extensive work-up after the MVC, which was unremarkable except for a computed tomography angiography (CTA) of the abdomen and pelvis. The CTA revealed an aneurysm involving the visceral segment of the proximal abdominal aorta above the right renal artery and directly across from one of two left renal arteries (Fig 1). Calcification of the aneurysmal sac clearly pointed to a chronic aneurysmal expansion of the aortic wall, rather than a pseudoaneurysm secondary to arterial trauma from the MVC. The absence of fever, leukocytosis, or periaortic inflammation on the CTA did not support an infectious process.

The patient's medical and surgical history was significant for hypertension and an appendectomy through a midline laparotomy. The result of a cardiac stress test was within normal reference ranges, with an ejection fraction of 70%, and she was felt to be an appropriate candidate for an open repair. The patient provided informed consent for surgical repair.

In light of the significant concern for the development of renal failure due to the necessary cross-clamp time, a temporary, external right axillofemoral bypass was created to allow retrograde perfusion of the renal arteries during the course of aortic clamping. Excellent flow was established through an 8-mm polytetrafluoroethylene (PTFE) graft.

Because of the right-sided orientation of the saccular aneurysm, a midline laparotomy was thought to be the best approach to the aortic aneurysm. Dissection was continued to the level of the duodenum after an extensive lysis of adhesions secondary to her prior midline laparotomy. During the exposure of the aorta and the renal arteries, the patient became hemodynamically unstable.

An inspection of the abdomen found the splenic capsule near the hilum was actively bleeding. The bleeding was ultimately controlled by hemostatic agents and manual compression, but due to the splenic bleeding and need for systemic anticoagulation during the aneurysmal repair, it was felt safer to abort the procedure and proceed to definitive repair within the next few days when heparin could be safely administered. The temporary axillofemoral bypass was removed using an Endo-GIA 30 stapler (US Surgical Corp, Norwalk, Conn), which left a 3-cm stump for future graft anastomosis and recreation of the bypass in the axillary and femoral locations. The abdomen and all surgical exposure sites were closed.

During the next week, the patient's recovery was unexpectedly slow and difficult. Because of concern of a repeat extensive open repair and her poor tolerance for the initial procedure, an endovascular option was contemplated. Careful review of the CTA and reconstructed images revealed a discrete neck suitable for occlusion by an ASO device. The origin of the superior mesenteric artery and right renal artery were distant enough to accommodate the inner disk (left atrial disk) of a 14-mm ASO.

After informed consent was obtained, general anesthesia was initiated, and the right femoral artery and the PTFE graft were

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Competition of interest: none.

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0741-5214/$36.00

doi:10.1016/j.jvs.2010.11.054

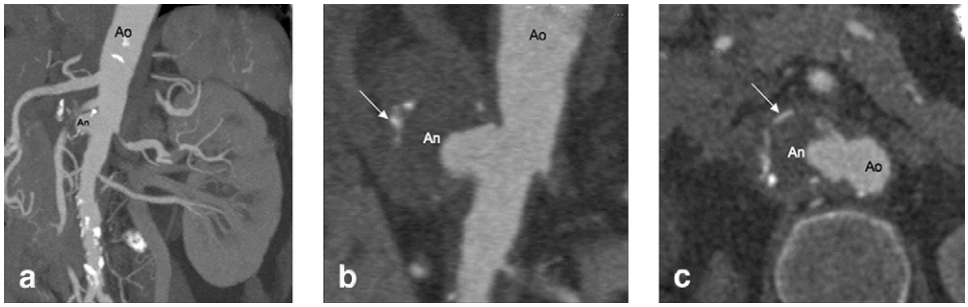

Fig 1. Computed tomography angiography shows the saccular aneurysm (*An*) of the abdominal aorta (*Ao*). The aneurysmal wall is calcified (*white arrow*).

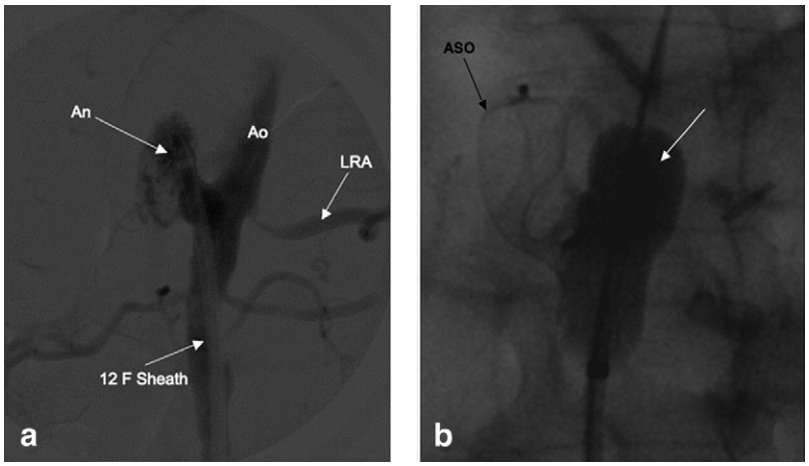

Fig 2. a, A 12F sheath has been advanced into the aneurysmal sac (*An*). An angiogram performed through the sheath shows the aorta (*Ao*), the aneurysm sac (*An*), and the left renal artery (*LRA*). **b**, The left atrial disk of the atrial septal occluder (*ASO*) has been modeled into the inner surface of the saccular aneurysm. The right atrial disk is expanded along the inner surface of the aorta. A CODA balloon (*white arrow*) is used to provide the best apposition and seal the right atrial disk to the aortic wall.

exposed. The patient was then systemically heparinized (100 U/kg). The graft was then thrombectomized, and an 8F sheath was placed into the conduit. An aortogram was performed to locate the aneurysm and identify the right renal artery and superior mesenteric artery. Under a magnified view, a 7F multipurpose angiographic (MPA) catheter and an angled glidewire were used to selectively catheterize the saccular aneurysm. The glidewire was exchanged for a Rosen wire. Next, the MPA catheter and 8F sheath were removed, and a 12F sheath required for placement of the 14-mm ASO device was advanced over the Rosen wire and into the aneurysm sac (Fig 2, *a*). Additional angiographic views were obtained.

The ASO was then advanced through the sheath and deployed slowly. The outer larger disk (left atrial disk) modeled into the inner surface of the saccular aneurysm. The smaller disk (right atrial disk) expanded along the inner surface of the aorta. A CODA balloon (Cook Inc, Bloomington, Ind) was then used to provide the best apposition and seal the ASO device to the aortic wall (Fig 2, *b*). A completion angiogram showed almost total cessation of flow in the aneurysmal sac and patent visceral arteries. At this point, the PTFE graft was stapled just beyond the arterial anastomosis, and the groin exposure was closed.

The patient tolerated this procedure well, with no change in her renal function. CTA imaging at 72 hours and at 30 days showed a well-apposed ASO device and an excluded aneurysm sac with patent visceral arteries (Fig 3).

DISCUSSION

The Amplatzer ASO for atrial septal closure is a self-expandable, double-disk device made of nitinol wire mesh with a connecting waist to fill the atrial septal defect. Polyester fabric inserts sewn within each disk are designed to help close the defect, occlude blood flow through the device, and provide a foundation for growth of tissue over the occluder after placement. The ASO is available in different sizes to treat septal defects from 4 to 38 mm, with the smaller disk (right atrial) measuring 12 to 48 mm and the larger disk (left atrial) ranging 16 to 54 mm.

Aortic pseudoaneurysms can occur infrequently from anastomotic dehiscence of suture lines or cannulation sites from previous cardiac or aortic surgery, in particular, the ascending aorta. Previously published case series have reported transcatheter closure of aortic pseudoaneurysms

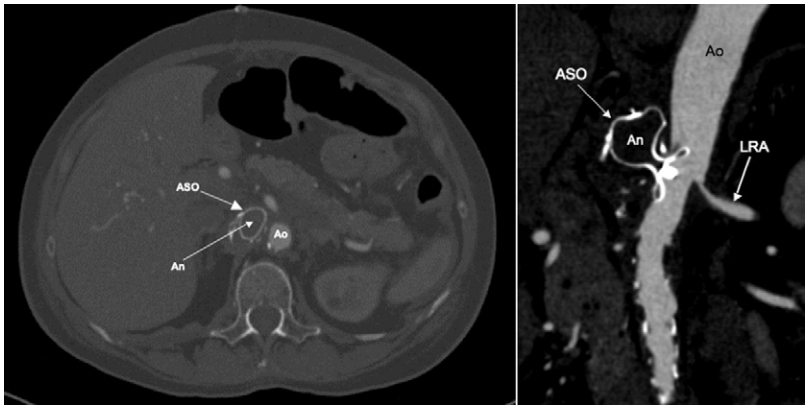

Fig 3. A computed tomography angiography shows the left renal artery (*LRA*) and the atrial septal occluder (*ASO*) device in the successfully thrombosed saccular aneurysm (*An*).

using an ASO.[1-5] A follow-up period of up to 18 months with successful exclusion has been reported.

To our knowledge, this report documents the first successful exclusion of a true aortic aneurysm using this technique to be reported in the literature. The placement of an ASO offers, in suitable anatomy, an alternate endovascular treatment option for saccular aneurysm exclusion. The physiology, flow dynamics, and consequently, the treatment goal differs in cases of saccular and fusiform aneurysms. In this patient, rather than providing integrity to the aortic wall, we aimed to effectively decrease the blood flow and pressure in the saccular aneurysm. This approach allows complete thrombosis of the residual aneurysm sac, and as a result, prevents further expansion of the aneurysmal sac. Several points with respect to selection and placement of the septal occluder device should be noted:

- Adequate deployment of the ASO and optimal choice of device size has to take into account the possibility of flow obstruction to the visceral circulation.
- Thin-cut CTA imaging is required to accurately evaluate the target zone. Precise imaging allows sizing of the saccular neck diameter ("defect size") and measurement of the distance to the origin of any of the visceral branches. CTA imaging also helps identify an infectious process involving the aortic aneurysm. A mycotic aneurysm should always be considered in the presence of a saccular aneurysm, particularly in the visceral segment of the aorta.
- An angiogram before complete release of the device from the delivery system can confirm correct placement and visceral artery patency. If device placement is unsatisfactory, the ASO device can be recaptured, retracted, repositioned, or completely retrieved and resized.

An alternate septal occluder device considered in our case was the Helex Septal Occluder (W. L. Gore and Assoc, Flagstaff, Ariz), which is composed of expanded PTFE patch material supported by a single nitinol wire frame. We preferred the nitinol Amplatzer ASO for its likely better ability to conform to the saccular aneurysm sac.

CONCLUSIONS

Open repair of saccular abdominal aortic aneurysms of the visceral segment is the recommended treatment option in patients with surgically acceptable risk. In high-risk patients, however, an alternate endovascular option should be strongly considered. Our patient underwent an open procedure that was aborted. Despite her adequate preoperative risk stratification, her recovery was extremely difficult, and the placement of an ASO was seen to be an alternate solution to successfully exclude this large aneurysm.

Although long-term follow-up is necessary to establish the efficacy of this treatment option, our 1-month follow-up CTA showed complete thrombosis and stabilization of the aneurysmal sac. This result is encouraging, and as such, ASO devices can potentially be a useful option for the treatment of certain saccular aortic aneurysms, especially when the visceral vessels prevent the use of standard endovascular techniques.

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Submitted Sep 10, 2010; accepted Nov 6, 2010.