Transluminal thrombin injection and exclusion of a paramesenteric abdominal aortic aneurysm

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Surgical repair of aortic aneurysms involving the visceral arteries carries high morbidity and mortality in poor surgical candidates. With current technology, visceral artery involvement generally precludes endovascular repair of aortic aneurysms. We report on a patient with a large abdominal aortic pseudoaneurysm involving the origin of the superior mesenteric artery. This aneurysm was successfully repaired by transluminal thrombin injection of the sac and exclusion with balloon expandable covered stents placed in the aorta. (J Vasc Surg 2004;39:1118-21.)

The surgical treatment of aneurysms confined to the suprarenal abdominal aorta requires an extensive surgical exposure and supraceliac aortic clamping. This magnitude of surgery is not well tolerated by patients with major comorbidities and may not be advisable in patients with limited life expectancy. Under these circumstances, a less invasive approach is advisable. Anecdotal experience with covered stents, fenestrated covered stents, branched endografts, and embolotherapy with or without a combined surgical procedure has been reported. Currently, only aneurysms with favorable anatomic features are amenable to endoluminal repair. The present case describes the use of transluminal thrombin injection and covered stents to thrombose and exclude a large pseudoaneurysm arising adjacent to the orifice of the superior mesenteric artery (SMA) and just distal to the celiac artery.

CASE REPORT

A 68-year-old man with severe emphysema and coronary artery disease was found during evaluation for a pulmonary nodule to have a 5-cm aortic pseudoaneurysm (PA) arising between the origins of the celiac and renal arteries (Figs 1 and 2). The patient had had bacterial endocarditis three months before, and had undergone an aortobifemoral bypass 3 years earlier for claudication.

The patient had been afibrile for over two months, had negative blood cultures, a normal leukocyte count, and a slightly elevated sedimentation rate, and no valve vegetations were seen on echocardiogram. Therefore, we believed that the patient was not septic and the PA was not infected. An angiogram revealed that the PA originated between the celiac and the renal arteries, involving the SMA origin, with proximal occlusion and distal reconstitution of the SMA. The aortobifemoral bypass graft was patent, and its proximal anastomosis was not related to the PA. The computed tomography (CT) scan revealed that the origin and proximal SMA were compressed by the PA arising from the more proximal aorta, and that there was no inflammation around the PA, with no suggestion of infection. Therefore, given the patient’s comorbidities, endoluminal treatment was recommended because it was felt to be a lower-risk option that open repair. Angiography and CT scan measurements showed short landing zones (<1 cm) between the PA neck and the celiac artery proximally and slightly longer proximal to the renal arteries.

Perioperative intravenous antibiotics were given for subacute bacterial endocarditis prophylaxis. During surgery, the right limb of the aortobifemoral graft was exposed in the groin, and percutaneous access was gained to the left. In addition, the right brachial artery was cannulated to allow antegrade access to the celiac artery (the left arm had diminished pulses). A 4-cm-long balloon-expandable stent (Palmaz XL P4010, Cordis, Johnson & Johnson Co, Piscataway, NJ) was covered with polytetrafluoroethylene expanded to 25 mm, and was mounted on a 25 × 40-mm angioplasty balloon. The patient was heparinized. Under fluoroscopy, a 5 French selective visceral catheter was placed over a guidewire through the left femoral sheath into the PA sac and a bare 4.25 × 40-mm angioplasty balloon was placed in the aorta through the right femoral sheath, and inflated across the origin of the PA neck. To prevent thrombin spillage, a small volume of contrast was injected into the sac to ascertain its seal, and then aspirated (Fig 2, left). After aspiration of 4 mL of blood, 4000 units of bovine thrombin in a 4-mL solution were injected into the sac through the visceral catheter. This produced extensive thrombosis of the sac, but a small amount of flow persisted (Fig 2, right). After removal of the visceral catheter and balloonloon, the covered stent was deployed through a 22 French valved sheath (Keller-Timmermans introducer, Cook Inc, Bloomington, Ind) between the celiac and renal arteries. An angiogram visualized a small residual proximal endoleak. This was corrected by deploying an additional covered stent slightly proximal to the initial one, just distal to the celiac artery origin. A completion angiogram demonstrated complete exclusion of the PA, but absence of flow into the celiac artery. It was apparent that the aortic stents had displaced the PA anterosuperiorly, and that the PA in turn was pushing the celiac artery upwards. To correct this, a 6 × 40-mm balloon-expandable stent was deployed in the celiac artery, restoring its patency (Fig 3).

Following surgery, the creatinine remained normal and there were no abdominal problems. The patient was discharged from the hospital on the second postoperative day. Two weeks later, the patient underwent a curative lung resection for cancer. Six months...
Fig 1. CT scan with contrast demonstrating a large aortic pseudoaneurysm arising at the level of the superior mesenteric artery (left) and three-dimensional CT reconstruction (right) showing the perivisceral origin of the pseudoaneurysm encroaching the superior mesenteric artery, and the proximity of the celiac and renal arteries.

Fig 2. Left, Contrast injection into the pseudoaneurysm sac through a selective visceral catheter with an inflated aortic balloon in place. It denotes that the sac is sealed from the aortic flow allowing safe injection of thrombin. Right, Angiogram following thrombin injection and removal of the aortic balloon. It demonstrates residual flow into the sac (arrow) and the upwards displacement of the celiac artery by the pseudoaneurysm.
When the origins of the visceral vessels are not involved by the aneurysm, a fenestrated endograft is an option. This was technically feasible in a case where the aortic pseudoaneurysm originated in the posterior aspect of the aorta, allowing the fenestrated portion of the endograft to face anteriorly against the visceral arteries while the non-fenestrated portion obliterated the PA neck. Rather than using a commercially available aortic cuff, we opted to use a handmade balloon-expandable, fully covered stent because, in our experience, it provides greater precision during deployment and gives a tighter fit in the aorta, perhaps decreasing the risk of endoleak. Precision during delivery was particularly important in this case because of the limited space for additional stenting distal to the celiac artery. We believe that the combination of a balloon-expandable covered stent with thrombin injection of the sac was the best choice to produce aneurysm exclusion and thrombosis with a single procedure.

The complexity and potential complications of these procedures, however, is illustrated in Madhavan’s report of a suprarenal mycotic aortic aneurysm treated with a combined approach using a stent partially covered with autogenous iliac artery deployed through an infrarenal aortotomy. The procedure was complicated by renal failure, paraplegia, and ischemic colitis, sparing none of the major complications of suprarenal aortic surgery. Visceral ischemia did not develop in our patient perhaps because the celiac artery was occluded for only a few minutes. In anticipation of this problem, we attempted to place a wire in the celiac artery orifice prior to covered stent deployment, but we desisted because of technical difficulty, finally accessing the celiac artery from the groin.

When visceral arterial perfusion cannot be maintained by endovascular means, a combined open visceral bypass followed by aortic endografting across the visceral orifices is a reasonable alternative. This combined approach may provide a better chance for uneventful recovery and long-term survival in patients poorly suited for a supraceliac open procedure. Our case was unique in this regard, because the SMA was already chronically occluded. Therefore, we did not need to preserve its patency.

The use of a branched endograft deployed in the renal and the superior mesenteric arteries has been reported for the exclusion of a suprarenal abdominal aneurysm adjacent to the orifice of the SMA. However, to date, these branched grafts are not available, and their reliability in maintaining long-term perfusion of the visceral and renal arteries remains unproven.

In summary, our case illustrates how thrombin injection of a perivisceral aortic pseudoaneurysm can be safely done with aortic balloon occlusion across the PA orifice. In addition, using currently available commercial products, an endovascular graft can be custom constructed for deployment across or adjacent to the visceral vessels for the exclusion of paravisceral aortic pseudoaneurysms. This technique in combination with a visceral artery bypass can widely expand the applicability of endovascular exclusion of aneurysms confined to the suprarenal abdominal aorta, and...
should be considered in patients with high surgical risk. These endovascular procedures require detailed preoperative imaging and knowledge on the construction and delivery of custom-made endovascular devices.

REFERENCES


Fig 4. CT scan with intravenous contrast six months following endovascular treatment. Left, The covered stents are in place and the pseudoaneurysm has regressed almost completely without any sac enhancement. Right, Three-dimensional reconstruction showing the position of the aortic and celiac stents and the absence of significant residual pseudoaneurysm.