

# Repair of superior mesenteric artery bypass pseudoaneurysm with physician-modified fenestrated aortic endograft

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**Aneurysmal degeneration and pseudoaneurysm formation of visceral vein bypass grafts are rare conditions that may be associated with rupture requiring reintervention. This case represents the first report of an enlarging, complex aorta to superior mesenteric artery vein bypass pseudoaneurysm repaired using a physician-modified fenestrated aortic graft with suprarenal fixation. (J Vasc Surg Cases 2015;1:224-7.)**

Superior mesenteric artery (SMA) pseudoaneurysm is one of the rarer types of visceral artery pseudoaneurysm, with an unreported rate of occurrence. The etiology is often associated with trauma, inflammation, or iatrogenic injury related to previous surgical intervention as well as exceedingly rare reports of aneurysm and pseudoaneurysm degeneration of visceral vein bypass grafts. Repair of visceral artery pseudoaneurysms is encouraged in the elective setting, given the high morbidity and mortality associated with acute rupture.<sup>1-13</sup> We describe a physician-modified, fenestrated aortic endograft with suprarenal fixation to facilitate the repair of a growing aorta to SMA saphenous vein bypass graft pseudoaneurysm in a patient with a hostile abdomen. Patency without endoleak was confirmed at 1 month and 5 months postoperatively. The patient's consent was obtained for publication.

## CASE REPORT

A 54-year-old male white veteran with hypertension and chronic obstructive pulmonary disease was referred after surveillance ultrasound and follow-up computed tomography (CT) revealed enlargement (3.4 cm from 2 cm during the last 3 years) of a known infrarenal aorta to SMA bypass pseudoaneurysm. The patient had a history of a close-range gunshot wound to the abdomen 30 years before presentation and had undergone a series of five abdominal surgeries including exploratory laparotomy, an undetermined number of small bowel resections, and patch repair of his SMA and aorta.

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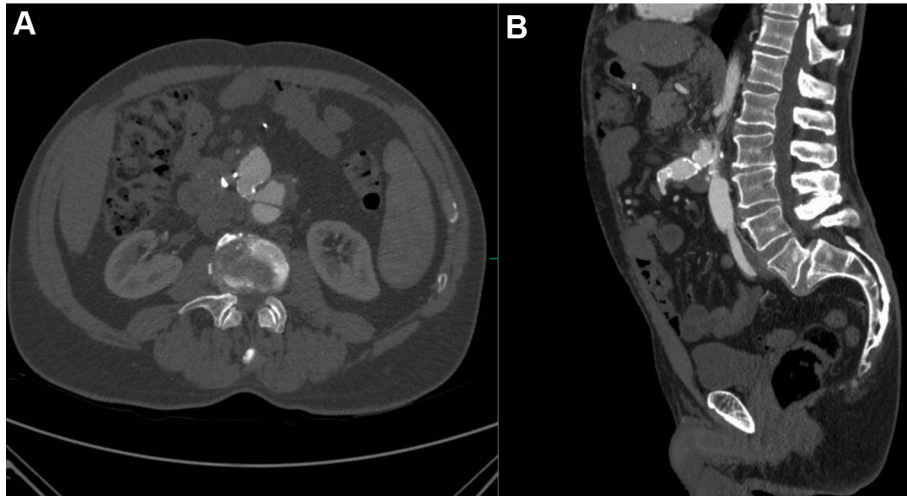
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The patient reported an additional surgery after the inciting event for occlusion of his aorta that resulted in an infrarenal aorta-SMA bypass with vein harvested from his right thigh.

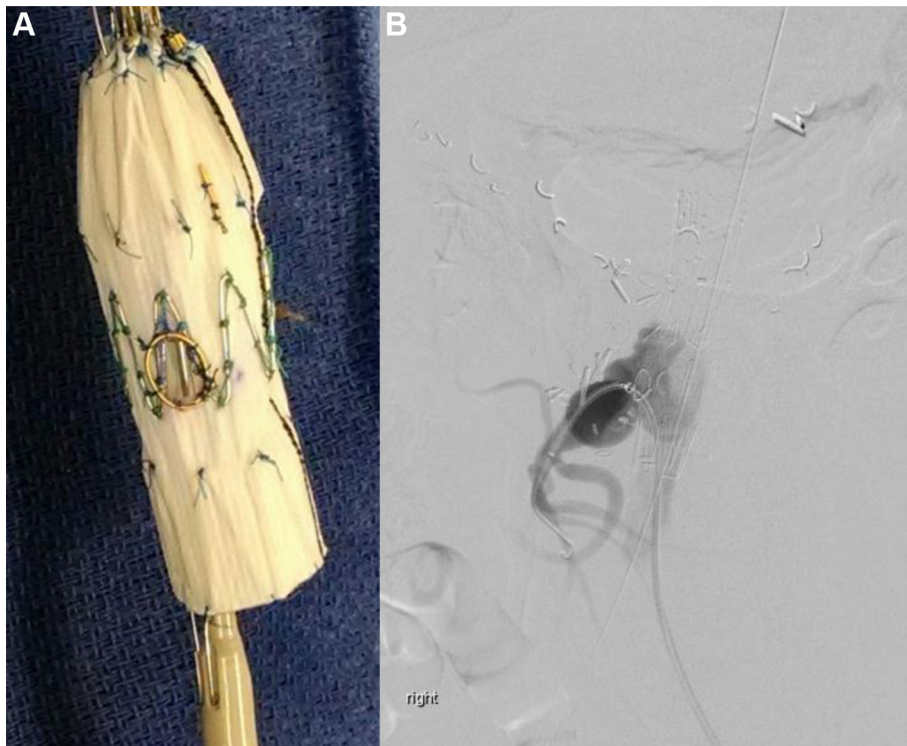
On presentation, the patient appeared older than his stated age and complained of intermittent abdominal pain that was not associated with oral intake. He denied weight loss, hemochezia, and melanic stools, although he endorsed dyspnea on exertion. His blood pressure was controlled with one medication. His abdominal examination was unremarkable aside from extensive midline scarring. The patient's preoperative laboratory values were normal, including a hematocrit of 45.2% and a serum creatinine level of 0.8 mg/dL.

CT angiography (CTA) demonstrated occlusion of the native SMA and a patent infrarenal bypass graft with complex saccular pseudoaneurysms involving both the proximal and distal anastomoses measuring 3.4 cm at the largest diameter (Fig 1). The celiac axis, renal arteries, inferior mesenteric artery (IMA), and bilateral iliac arteries were patent and otherwise unremarkable with the exception of aortic stenosis (1.6 cm in diameter compared with 2 cm) between the renal arteries and origin of the bypass graft.

The patient elected to proceed with a customized endovascular repair. A Renu (Cook Medical, Bloomington, Ind) proximal cuff with suprarenal fixation measuring 22 mm in diameter and 62 mm in length was unsheathed on the back table, where a 6 × 8-mm reinforced fenestration was created (Fig 2, A). Chromic sutures were used in a circumferential manner to constrain full deployment, thus permitting intravascular endograft manipulation. The graft was resheathed after anterior vertical and posterior horizontal markers were placed. The bilateral groins were accessed percutaneously, and the main device was advanced to the juxtarenal abdominal aorta through the right common femoral access. With use of CT fusion and iGuide software (Siemens Healthcare, Malvern, Pa), the ostium of the SMA bypass from the infrarenal abdominal aorta was identified and confirmed with angiographic guidance, and the aortic device was successfully deployed, still partially constrained by the chromic sutures. The fenestration and SMA bypass were selectively catheterized (Fig 2, B) from the contralateral side, and a Coda balloon (Cook Medical) was used to release the chromic sutures and to fix the endograft. A 7 F sheath was advanced through the fenestration and into the bypass graft over a Rosen wire, where two 8 × 38-mm balloon-expandable covered stents were deployed and balloon molded to 9 mm and 10 mm within the aortic stent graft for flaring



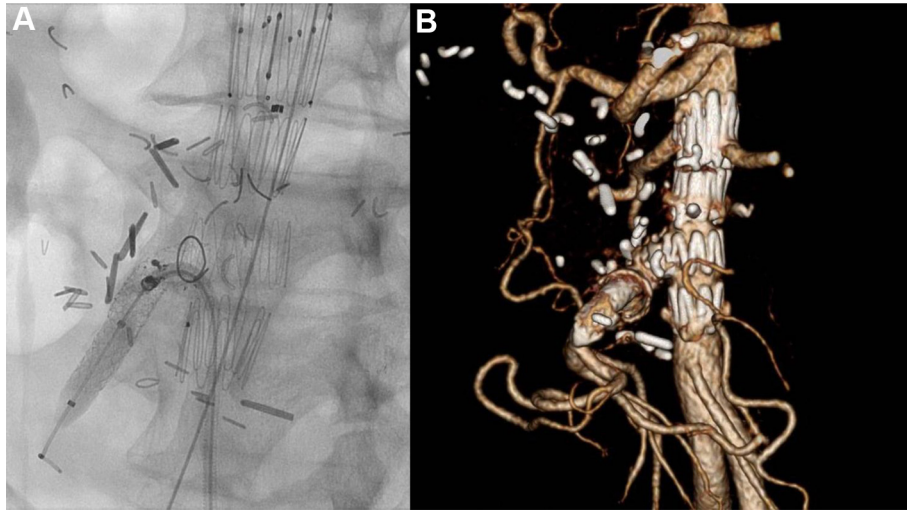
**Fig 1.** A, Axial view of computed tomography angiography (CTA) demonstrating complex saccular pseudoaneurysm of the superior mesenteric artery (SMA) bypass graft. B, Sagittal view demonstrating complex pseudoaneurysm with associated aortic stenosis.



**Fig 2.** A, Physician-modified fenestrated aortic graft. B, Fluoroscopic image of partially deployed aortic stent and canalization through the fenestration into the superior mesenteric artery (SMA) bypass pseudoaneurysm demonstrating the multiple branching points at the distal anastomosis.

purposes. A third  $7 \times 16$ -mm balloon-expandable covered stent was deployed to exclude residual retrograde filling of the pseudoaneurysm and balloon molded proximally to 9 mm. The subsequent arteriogram revealed resolution of the endoleak with widely patent branches distally.

The patient was started on aspirin and clopidogrel on postoperative day 0. Follow-up CTA was obtained to evaluate cramping abdominal pain expressed by the patient on postoperative day 1 and demonstrated widely patent renal arteries, SMA, and IMA and successful exclusion of the SMA bypass pseudoaneurysm



**Fig 3.** **A,** Fully deployed aortic graft with active stent deployment. **B,** Postoperative three-dimensional reconstruction (TeraRecon, Foster City, Calif) demonstrating pseudoaneurysm exclusion with patent celiac axis, renal arteries, and inferior mesenteric artery (IMA).

with no evidence of endoleak (Fig 3). The patient's diet was subsequently advanced, and he was discharged home on postoperative day 2. Follow-up CTA at 1 month, 5 months, and 15 months demonstrated graft and stent patency with a shrinking aneurysm sac. We plan to observe the patient with yearly CTA.

## DISCUSSION

There is a single case report describing pseudoaneurysmal degeneration of a hepatic vein bypass graft requiring repair for hemorrhage as well as only two reports of delayed rupture complicating aortorenal vein bypass grafts.<sup>14,15</sup> In general, more common saphenous vein bypass complications include arterialization and subsequent stenosis as well as thrombosis as often cited in both the coronary and the peripheral vascular bed literature.<sup>15</sup> This is the only case report of an aorta-SMA vein bypass pseudoaneurysm demonstrating rapid growth 30 years postoperatively.

Native visceral artery aneurysms and pseudoaneurysms have an autopsy and angiographic incidence of <2%.<sup>6,11</sup> Most commonly, they undergo operative intervention if they are symptomatic, are >2 cm in diameter, exhibit a growth rate >0.5 cm/y, or are present in women of child-bearing age.<sup>11</sup> Symptoms are often described as abdominal pain, evidence of gastrointestinal bleeding, and hemodynamic instability.<sup>6,7</sup> Although open surgical repair is often associated with longer durability, in the setting of a hostile abdomen, the patient is at increased risk of perioperative morbidity and mortality.<sup>8,11</sup>

Operative options were discussed with our patient, who adamantly refused open surgery; he believed he would not survive and described having arrested a total of seven times during his distant explorations. We similarly believed he would be at a high risk for operative mortality and certainly morbidity due to a hostile and likely frozen abdomen. Although the pseudoaneurysm was saccular, it

was complex, serpiginous, and multidimensional, making success with coils or embolization without occlusion of the distal SMA branching points unlikely. Because of the involvement of the pseudoaneurysm at the proximal anastomosis, we did not believe commercial stents would adequately exclude the origin. In addition, we were interested in maintaining patency of his IMA and minimizing the extent of graft coverage along his uninvolved aorta.

With these considerations in mind, we had an extensive discussion with the patient regarding the off-label use of a short aortic cuff to customize an endovascular repair. We believed the use of suprarenal fixation obviated the necessity for a three-vessel fenestration while decreasing the risk of graft migration. We explained the risks of maldeployment, inability to cannulate the fenestration, need for conversion to open surgery, stent thrombosis, and lack of data regarding long-term outcomes of physician-modified grafts. As the patient's pseudoaneurysm had evidence of recent enlargement and because of his desire to avoid an open surgery, he elected to proceed with a physician-modified aortic graft with stent exclusion.

The aortic endograft served to secure the proximal landing zone of the covered stent for total pseudoaneurysm exclusion. Perfusion to the bowel was preserved through maintaining patency of multiple SMA branching points as well as of the IMA. The procedure was accomplished completely percutaneously in 3.5 hours, and the patient was discharged on postoperative day 2.

## CONCLUSIONS

The benefits of an elective and customized endovascular repair include decreased mortality and shorter recovery.<sup>16</sup> Although the intervention requires preprocedural planning, knowledge of current devices available, and back-table manipulation, these elements are not beyond

our current scope of practice. With an expanding case volume and increasing experience and creativity of endovascular interventionalists, novel solutions will continue to evolve for what, historically, represent challenging open reconstructions in the setting of a hostile abdomen.

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