

## Endovascular aneurysm repair with inferior mesenteric artery chimney in a high-risk patient with abdominal aortic aneurysm and iliac occlusion

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### ABSTRACT

A 63-year-old man presented for the treatment of abdominal aortic aneurysm in the setting of bilateral internal iliac artery compromise from prior peripheral arterial disease treatments. The inferior mesenteric artery (IMA) measured 5 mm. Patient underwent coronary artery stenting 6 months prior and experienced left leg claudication. He underwent endovascular aneurysm repair with chimney IMA grafting and a femorofemoral bypass with uneventful recovery. At 1 year, computed tomography angiogram shows no flow in the aneurysm sac, and his left leg claudication resolved. Endovascular aneurysm repair with chimney IMA grafting for colonic perfusion preservation is a reasonable alternative to open surgical repair with IMA reimplantation in high-risk patients. (*J Vasc Surg Cases Innov Tech* 2022;8:28-31.)

**Keywords:** Abdominal aortic aneurysm; Chimney graft; Endovascular aneurysm repair (EVAR); Inferior mesenteric artery

Endovascular aneurysm repair (EVAR) is a less invasive treatment of abdominal aortic aneurysms (AAAs) specially for patients with significant comorbidities. During EVAR, the inferior mesenteric artery (IMA) origin is routinely covered, and colonic perfusion is preserved through collaterals from the internal iliac arteries (IIAs) and the superior mesenteric artery (SMA). The Society for Vascular Surgery recommends preservation of at least one IIA during EVAR.<sup>1</sup> Despite the low incidence of colonic ischemia estimated at 0.5%, this complication increases morbidity, hospital stay, and mortality (>50%) in patients undergoing AAA repair.<sup>2,3</sup>

This report demonstrates the management of a high-risk patient with a 6.4 cm AAA and bilateral IIA compromise from prior peripheral arterial disease (PAD) treatments. The patient underwent successful EVAR with chimney IMA stenting and femorofemoral

bypass. Written informed consent was obtained for this publication.

### CASE PRESENTATION

A 63-year-old male patient presented for evaluation of an infrarenal AAA 6.4 × 5.4 cm. His past medical history included hypertension, hyperlipidemia, chronic kidney disease stage 3 (baseline creatinine 1.67 mg/dL, estimated glomerular filtration rate 51 mL/min/1.73 m<sup>2</sup>), coronary artery disease with coronary artery bypass grafting 8 years prior, PAD (s/p bilateral iliac artery stents 23 years prior and left superficial femoral artery stents 8 years prior). He continued smoking with a history of 50 pack-years. Six months prior, he underwent right coronary artery stenting after a positive stress test. The patient also experienced lifestyle limiting left leg claudication and had an ankle brachial index of 0.61. Computed tomography angiogram revealed the AAA with an angulated neck and the associated thrombus with a large 5 mm IMA (Fig 1). The iliac arteries were bilaterally stented with total occlusion of the left iliac system and patency of the right iliac artery stent jailing the right IIA origin causing near occlusion (Fig 1). To preserve colonic flow, EVAR with chimney IMA stenting was performed. To prevent worsening of left leg claudication symptoms from coverage of collaterals, a concomitant right-to-left femorofemoral bypass was planned.

Under general anesthesia, open left brachial artery exposure was performed to obtain vascular access. An 8F sheath was advanced to the suprarenal aorta. CO<sub>2</sub> angiography was used selectively to minimize iodinated contrast use, and the IMA was confirmed to be large (at least 5 mm in diameter) (Fig 2). Two 5 × 87 VBX stent grafts (W.L. Gore & Associates, Flagstaff, Ariz) were deployed approximately 2-3 cm into the IMA without covering side branches and bringing the proximal orifice to the suprarenal position. Next, using open right common femoral artery access, a 25 mm Aorto-Uni-Iliac endograft-Endurant II was

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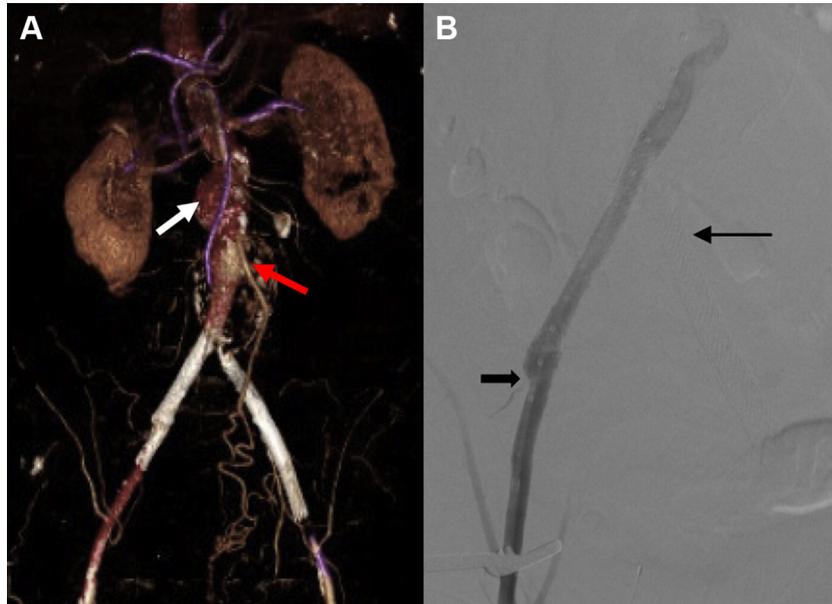
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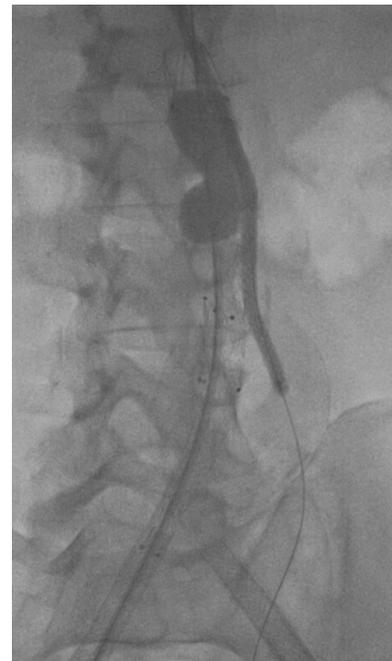
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**Fig 1.** Preoperative images. **A**, Infrarenal abdominal aortic aneurysm (AAA) with an angulated neck (*white arrow*), inferior mesenteric artery (IMA) (*red arrow*), and patent right iliac artery stents jailing the ostium of the right internal iliac artery (IIA). **B**, Distal aortic and iliac angiography showing the thrombosed left iliac stent (*thin black arrow*) and the origin of the right IIA (*thick black arrow*).



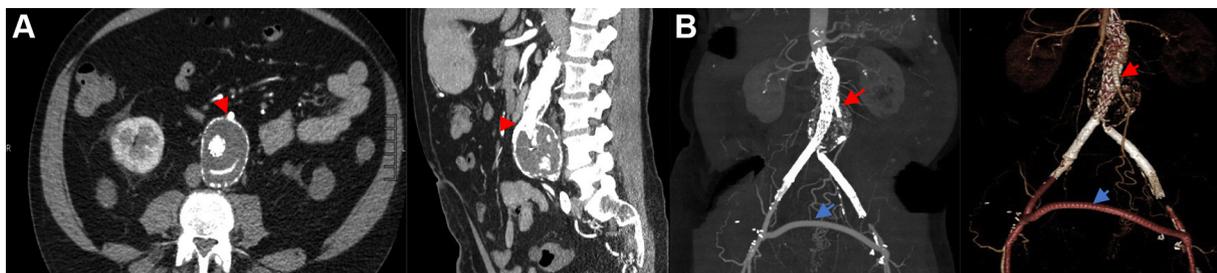
**Fig 2.** Lateral angiogram with CO<sub>2</sub> demonstrating the abdominal aortic aneurysm (AAA) and a large inferior mesenteric artery (IMA).



**Fig 3.** Kissing balloon angioplasty at the neck of the aneurysm and the chimney stent grafts into the inferior mesenteric artery (IMA).

advanced (Medtronic Cardiovascular, Santa Rosa, Calif) to the level of renal arteries. Once deployed, the graft was extended with a 16 × 10 iliac limb into the common iliac artery. In addition, a 5 × 150 Mustang balloon dilatation catheter (Boston Scientific, Marlborough, Mass) was advanced into both stents to perform kissing balloon angioplasty with a Coda balloon (Cook Incorporated, Bloomington, Ind). A balloon-expandable graft stent rather than a self-expandable graft stent was used to allow greater deployment control and precision. The completion

angiogram showed a type Ia endoleak, which decreased after repeat kissing balloon angioplasty. There was a small “gutter” endoleak or a possible type II endoleak from the lumbar arteries (Fig 3), but no additional interventions were done for the endoleak. The right-to-left femorofemoral bypass was performed using an 8 mm ringed Gore-Tex graft (W.L. Gore & Associates). The



**Fig 4. A,** Postoperative images demonstrating the patent inferior mesenteric artery (IMA) chimney stent (red arrowheads) with no evidence of endoleak. **B,** Computed tomography angiography scan showing patent IMA stent (red arrows) and femorofemoral bypass (blue arrows) at 1-year follow-up.

procedure was completed using 30 mL of iodinated contrast only. After an uneventful 3-day hospital course, the patient was discharged with a stable postoperative creatinine of 1.4 mg/dL.

Initial postoperative computed tomography angiogram demonstrated a small type Ia endoleak that resolved spontaneously and was not evident at 6-month and 1-year imaging (Fig 4). The AAA size decreased to 6.3 cm × 4.9 cm. The patient was monitored closely. The alternative plan was to extend the sealing zone and place chimney grafts into the renal arteries if the gutter leak did not resolve and the aneurysm expanded. The patient's ankle brachial index increased to 0.8. He remains without claudication symptoms and no reintervention at 18 months after surgery.

## DISCUSSION

This report highlights a challenging AAA repair in a high-risk patient with the need to preserve IMA perfusion to distal colon and rectum due to extensive iliac disease. Colon perfusion is necessary to prevent ischemic colitis, a rare but lethal AAA repair complication. IMA preservation during EVAR should be considered in cases of celiac artery, SMA or bilateral IIA occlusion, or previous colon procedures disrupting the collateral network.<sup>4,5</sup> In our patient, because bilateral iliac stents were placed 23 years prior, AAA repair was not considered at that time. In addition, although traditional open AAA repair would have involved IMA reimplantation in this case, the patient was not a candidate due to his advanced cardiac disease with recent coronary stenting and many comorbidities. In the absence of commercial dedicated devices for IMA preservation, EVAR with IMA chimney stenting was the optimal treatment.

Chimney EVAR deploys parallel stents into the visceral branches, which could otherwise be covered by the adjacent aortic endograft.<sup>6,7</sup> This technique has become more popular, especially in urgent cases, when commercial custom-manufactured devices are unavailable. However, limited reports describe IMA chimney stenting. This method was successfully used in a patient with the horseshoe kidney who also underwent partial nephrectomy to treat transitional cell carcinoma.<sup>8</sup> IMA chimney stenting was also performed for a patient with previous bowel resection, relaparotomy (four times), chronic

SMA occlusion, and hypertrophic IMA.<sup>9</sup> Chimney EVAR was the treatment of choice for a patient with abdominal aortic and IMA aneurysms, and chronic occlusion of celiac artery and SMA at the ostia.<sup>5</sup>

The main chimney EVAR limitation is type Ia endoleaks that require secondary interventions in 3%-28% of cases but tend to resolve spontaneously.<sup>10</sup> A study examining the incidence and natural history of this limitation showed that even though type Ia endoleaks were noted on 30% of initial postoperative imaging, they resolved in 47.3% and 71.8% of patients at 6- and 12-month follow-up, respectively.<sup>11</sup> Therefore, this technique is relatively safe, cost-effective, and has been increasingly used for high-risk patients with complex anatomy who cannot tolerate extensive open repair.<sup>12</sup>

For patients with strong collateral networks, IMA coverage by the aortic graft may not present immediate danger and could remain asymptomatic. However, AAA repair in patients with significant iliac disease burden must consider IIA preservation to prevent colonic ischemia. One report described chimney EVAR in a patient with SMA occlusion and critical limb ischemia due to severe in-stent restenosis of the iliac arteries.<sup>13</sup> Similar to our case, the patient suffered a myocardial infarction 4 months prior and could not undergo an open procedure. A different study described the successful chimney IMA graft placement in two patients with bilateral IIA occlusion.<sup>4</sup> In our patient, both IIAs were compromised as well: the right IIA ostium was obstructed by the stent, whereas the thrombosis seen in the left iliac artery stents may have resulted from the embolization of the thrombus present in the AAA. Treatment efficacy evinced in the AAA shrinkage, graft patency with no endoleak or need for future reinterventions.

## CONCLUSIONS

The combination of open and endovascular techniques with judicious intravenous contrast use enabled effective and safe repair of concomitant AAA and PAD in a high-risk patient. EVAR with chimney IMA grafting is an important technique for colonic perfusion preservation in selected patients with aneurysms and PAD.

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