Endovascular aneurysm repair with mesenteric artery bypass for an abdominal aortic aneurysm with occlusion of celiac and superior mesenteric arteries

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ABSTRACT

A 67-year-old male patient required surgical management of an abdominal aortic aneurysm. A contrast-enhanced computed tomography showed a saccular infrarenal abdominal aortic aneurysm, with occlusion of the origins of the celiac artery, superior mesenteric artery, and inferior mesenteric artery. An aortography revealed large amounts of blood flow from capillaries around the abdominal aorta to the inferior mesenteric artery and retrograde blood flow to the meandering mesenteric artery through the superior rectal artery. Considering the risk of bowel ischemia, we performed endovascular aneurysm repair with mesenteric artery bypass. The operation was successful, and the postoperative course was uneventful. This procedure may be useful and less invasive. (J Vasc Surg Cases Innov Tech 2022;8:462-5.)

Keywords: Endovascular abdominal aneurysm repair; Abdominal aortic aneurysm; Mesenteric artery bypass

Endovascular aneurysm repair (EVAR) has become the mainstream surgery for an abdominal aortic aneurysm (AAA) in recent years.[1] Although EVAR can be used to treat AAA if its anatomy is met, in 20% to 30% of cases, short or angulated proximal neck or anatomical anomaly can make this procedure difficult.[2] The incidence of bowel ischemia after EVAR is low, at 0.8%, but once it occurs, it can have fatal consequences.[3] Special attention on bowel ischemia is required in cases with atypical vascular anatomy. In this article, a case of EVAR with left external iliac artery (EIA) to superior rectal artery (SRA) bypass for AAA with occlusion of the origins of celiac and superior mesenteric arteries is presented.

CASE PRESENTATION

A 67-year-old male patient with a history of multiple sclerosis was referred to our hospital for surgical management of an AAA. A contrast-enhanced computed tomography showed a 67-mm saccular infrarenal AAA, with occlusion of the origins of the celiac artery, superior mesenteric artery (SMA), and inferior mesenteric artery (IMA), as well as a dilated meandering mesenteric artery (MMA) and abundant capillaries around the abdominal aorta (Fig 1). An aortography revealed large amounts of blood flow from the capillaries to the IMA (Fig 2). A bilateral internal iliac angiography also confirmed retrograde blood flow to the MMA through the SRA (Fig 3). These results suggested that most organs in the abdominal cavity, including the intestines, were supplied with blood flow from the capillaries via the IMA and a collateral blood flow from bilateral internal iliac arteries (IIAs). Because the blood flow from the IMA would be lost after EVAR, and it was uncertain whether the collateral blood flow from IIAs could be enough for the organs, EVAR with mesenteric artery bypass was performed.

Under general anesthesia, a midline laparotomy was performed. After the left EIA was exposed, a junction of the IMA, the MMA, and the SRA was identified using an ultrasound examination, which was also confirmed by an intraoperative aortography. Considering that the diameters of the MMA and the SRA were almost the same as well as the risk of organ ischemia during anastomosis, the SRA was selected as a distal anastomotic site. After a proximal anastomosis with a saphenous vein to the left EIA was completed, the vein graft was retroperitoneally passed to the site of the distal anastomosis. The distal anastomosis to the SRA was performed with a clamped SRA. During the anastomosis, there was no sign of bowel ischemia.

After confirming good blood flow of the mesenteric artery bypass with a transit time flow meter and an angiography, EVAR was started. First, the third and fourth right lumbar arteries were embolized with coils (Target XL Detachable Coils; Stryker) to prevent a type 2 endoleak. Second, an Endurant II bifurcated endograft (ETBF2513C124EJ; Medtronic) was inserted from the left common femoral and gently deployed just below the left renal artery. Then, an Endurant II contralateral limb (ETLW1613C82J; Medtronic) was inserted from the right common femoral artery and deployed to the right distal common iliac artery before deploying a limb of the bifurcated endograft to the left distal common iliac artery. Finally, the IMA was ligated for

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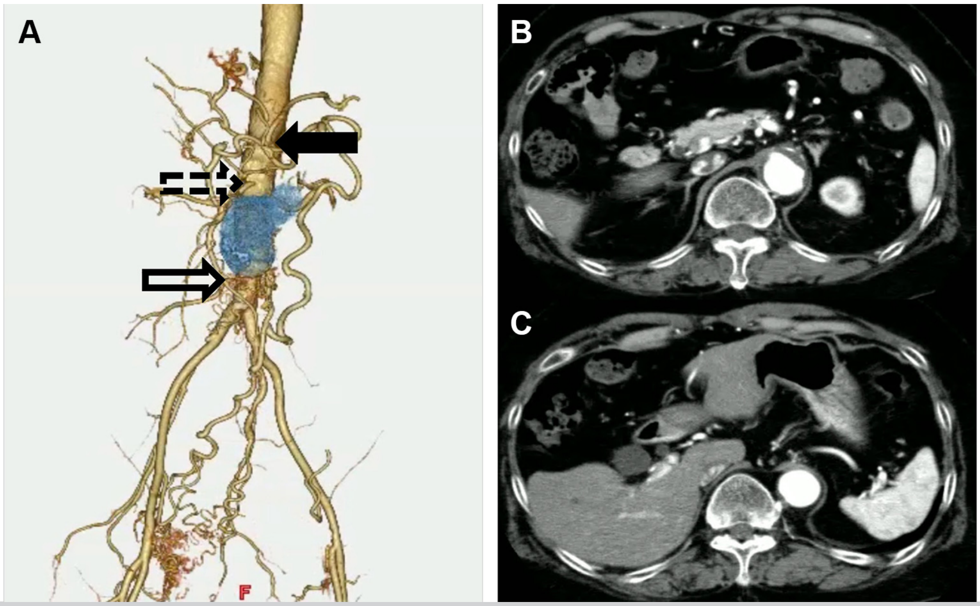

Fig 1. A, Three-dimensional reconstruction image, demonstrating a saccular abdominal aortic aneurysm (AAA) and a dilated meandering artery. *Black arrow*: celiac artery (CA); *dotted arrow*: superior mesenteric artery (SMA); *white arrow*: inferior mesenteric artery (IMA); *blue part*: saccular AAA. **B,** The occlusion of the origin of the CA. **C,** The occlusion of the origin of the SMA.

Fig 2. Aortography showed large amounts of blood flow from the capillaries to the inferior mesenteric artery (IMA) and meandering artery. *Black arrow*: IMA; *dotted arrow*: the capillaries around the aorta.

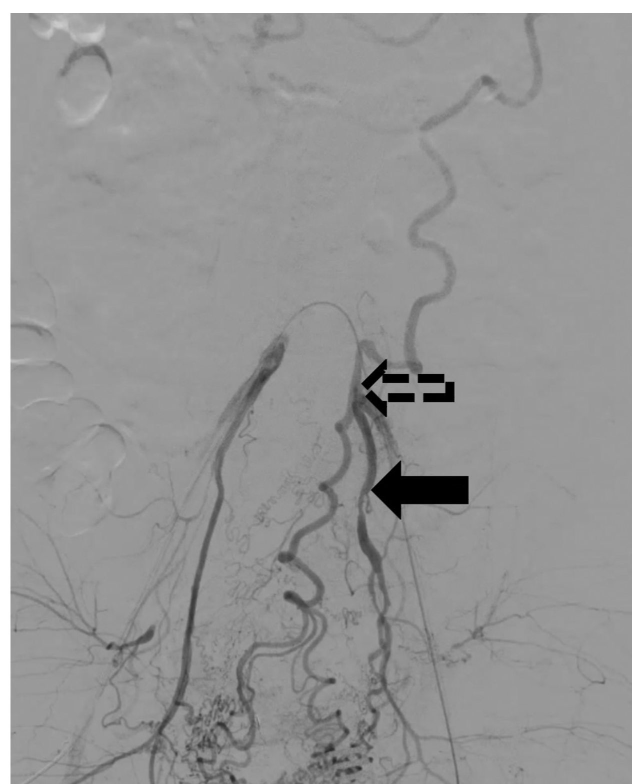

Fig 3. Bilateral internal iliac angiography showed retrograde blood flow to the meandering artery through the superior rectal artery (SRA). *Black arrow*: Lt. internal iliac artery; *dotted arrow*: superior rectal artery.

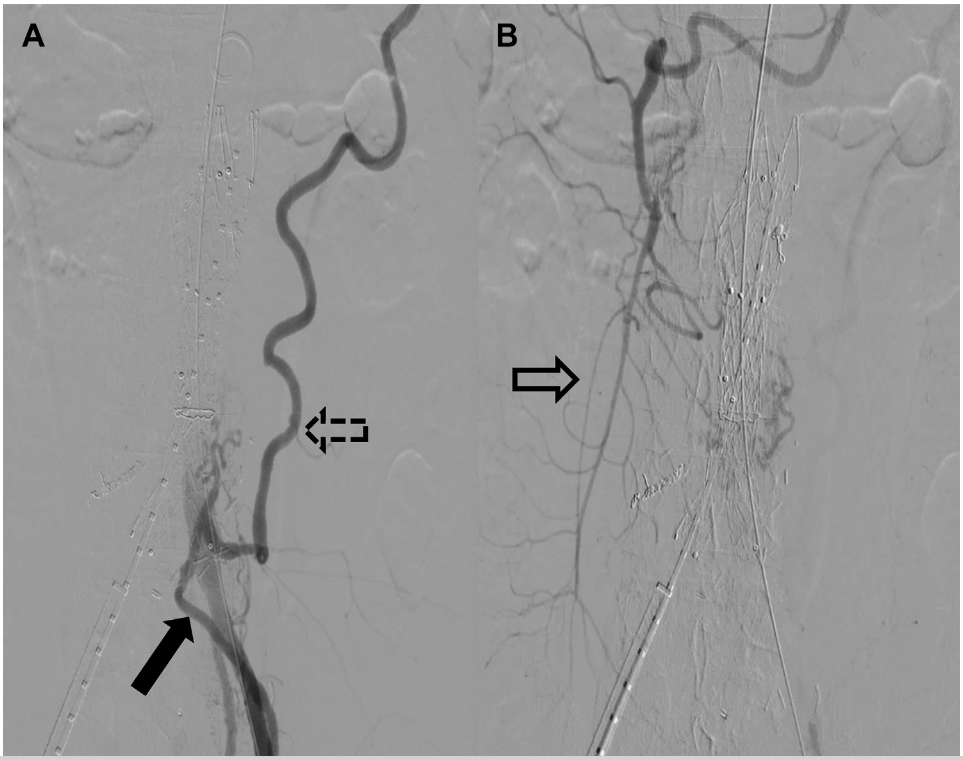

Fig 4. A, Blood flow from the saphenous vein graft to the meandering artery. *Black arrow*: saphenous vein graft; *dotted arrow*: superior rectum artery (SRA). **B,** Blood flow to the distal part of the superior mesenteric artery (SMA). *White arrow*: blood flow to the intestines.

the prevention of a type II endoleak. A completion aortography confirmed no endoleak and good blood flow to the MMA from both the SRA and the bypass (Fig 4). The patient's postoperative course was uneventful other than the need for repair of the left common femoral artery with an artificial vessel. A postoperative contrast-enhanced computed tomography 1 month after the operation demonstrated the patency of the bypass with no evidence of endoleak (Fig 5).

DISCUSSION

Currently, EVAR has been reported to be the most frequently performed operation for AAA.[1] Compared with open repair, EVAR's advantages include a decrease in postoperative morbidity, better quality of life, and so on.[1,4,5] However, in 20% to 30% of cases of AAA, short or angulated proximal neck or anatomical anomaly complicates conventional EVAR.[2] Additional procedures are considered as an option for such cases. In this report, a case of EVAR with mesenteric artery bypass for AAA with occlusion of the origins of celiac and superior mesenteric arteries was described.

At our hospital, lumbar arteries entering the AAA are embolized to prevent type 2 endoleak with coils as much as possible. In the present case, the third and fourth right lumbar arteries were embolized before performing EVAR.

It is challenging to choose an optimal surgical procedure for AAA that is associated with occlusion of the origins of celiac and superior mesenteric arteries. Open repair requires clamping infrarenal or suprarenal abdominal aorta, which would induce bowel ischemia due to a drastic reduction of blood flow from the IMA and IIA to the intestines. Therefore, an additional procedure to maintain blood flow to the intestines is required. A temporary mesentery artery bypass whose inflow is from the upper body, such as the subclavian artery, is an alternative.[6] Another procedure is utilizing visceral perfusion using an extracorporeal circuit similar to open thoracoabdominal aortic aneurysm surgery. However, these additional procedures are considered to be too invasive. On the other hand, EVAR itself obstructs blood flow to the IMA, and IMA embolization is sometimes required to prevent type 2 endoleak in cases of the dilated IMA. However, adding mesenteric artery bypass to the EVAR can secure blood flow to the intestines, which is less invasive and simple. In our case, as the anatomy of the AAA itself was suitable for EVAR, we decided to perform EVAR with a mesenteric artery bypass.

Mesenteric artery bypass is mainly used to treat chronic mesenteric ischemia. Although the most common mesenteric artery bypass is a bypass to the SMA, the SRA was selected as a target vessel in our case. There

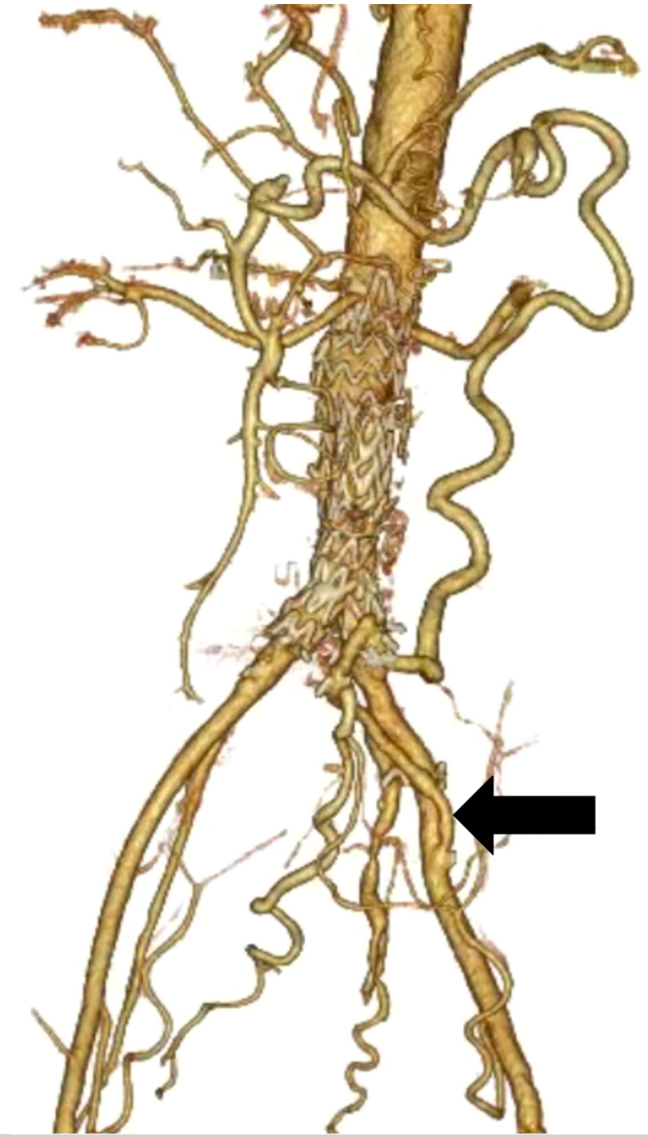

Fig 5. Three-dimensional reconstruction image 1 month after the operation confirmed the patency of the bypass with no evidence of endoleak. *Black arrow*: saphenous vein graft.

were several reasons for this. First, the diameter of the SMA was thin. Conversely, the SRA and the MMA were dilated enough to be anastomosed. Second, the risk of bowel ischemia was a concern. If the MMA was selected and not shunted, ischemia of the entire bowel would develop during anastomosis. In contrast, in case of the SRA, some blood flow to the intestine would be ensured from the IMA during anastomosis. Third, the IMA was also another option for the target vessel, but to prevent a type 2 endoleak, we had to ligate the IMA. Finally, there were concerns about graft kinking and long bypass in case of an SMA bypass. As our patient's AAA was saccular and large, and we could not expect how the AAA wound shrink after EVAR, they were more serious in our case. Hence, the SRA was selected as the target vessel.

CONCLUSIONS

A case of EVAR with a mesenteric artery bypass for AAA with occlusion of the origins of celiac and superior mesenteric arteries was presented. For cases with an atypical vascular anatomy, this procedure is useful and less invasive, although long-term follow-up is required.

We obtained the patient's consent to present the case and to provide vascular images.

REFERENCES

1. The Japanese Society for Vascular Surgery Database Management Committee Member, and NCD Vascular Surgery Data Analysis Team. Vascular surgery in Japan: 2014 annual report by the Japanese Society for Vascular Surgery. Ann Vasc Dis 2020;13:474-93.
2. Lerussi G, O'Brien N, Sessa C, D'Elia P, Sobocinski J, Perrot C, et al. Hepatorenal bypass allowing fenestrated endovascular repair of juxtarenal abdominal aortic aneurysm: a case report. Eur J Vasc Endovasc Surg 2010;39:305-7.
3. Gurakar M, Locham S, Alshaikh HN, Malas MB. Risk factors and outcomes for bowel ischemia after open and e^{n}dovascular abdominal aortic aneurysm repair. J Vasc Surg 2019;70:869-81.
4. Prinssen M, Buskens E, Blankensteijn JD; DREAM trial participants. Quality of life after endovascular and open AAA repair. Results of a randomised trial. Eur J Vasc Endovas Surg 2004;27:121-7.
5. Greenhalgh RM, Brown LC, Kwong GP, Powell JT, Thompson SG; EVAR trial participants. Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30-day operative mortality results: randomised controlled trial. Lancet 2004;364:843-8.
6. Sakamoto S, Yamauchi S, Yamashita H, Imura H, Maruyama Y, Ochi M, et al. Repair of an abdominal aortic aneurysm with a remarkably dilated meandering artery: report of a case. Surg Today 2007;37:133-6.