Technique for planning and implantation of a branched endograft as a proximal extension of a previous fenestrated endovascular aneurysm repair

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ABSTRACT

Our patient had undergone a previous three-fenestration Anaconda (Terumo Medical Corp, Tokyo, Japan) fenestrated endovascular aneurysm repair (EVAR) to treat a juxtarenal aortic aneurysm. At 10 years postoperatively, distal migration of the prosthesis, a proximal type I endoleak, and aortic sac enlargement of 10 mm in 6 months was observed. Because of the short length of the Anaconda's bifurcated body, we chose to use a Zenith custom-made endograft with four branches and a bifurcated body with an inverted contralateral limb. We have also described the issues that can arise during branched EVAR after fenestrated EVAR and some of the bailout techniques we performed to successfully perform the treatment. (J Vasc Surg Cases and Innovative Techniques 2021;7:100-3.)

Keywords: Aortic aneurysm; Branched device; Distal migration; Fenestrated device

Endovascular aneurysm repair (EVAR) has become the treatment of choice for aortic aneurysms for most patients.[1] A high proportion of these patients will not be candidates for standard endovascular treatment owing to the anatomic characteristics of the aneurysm.[2] The use of endografts that allow for proximal anchorage in the thoracic or visceral aorta and the inclusion of the ostium of the visceral arteries is necessary. Treatment with fenestrated endografts (FEVAR) and branched endografts (BEVAR) has resulted in good short- and medium-term outcomes, and their use has even been described as a proximal extension in cases of previous infrarenal EVAR failure.[3]

The presented technique involves the planning and implantation of a branched endograft as a proximal extension of a previous three-fenestration stent graft. We have also described several bailout techniques that allowed us to successfully perform the present case. The patient provided written informed consent for the report of his case.

SURGICAL TECHNIQUE

Preoperative planning. The patient had undergone surgery for a 60-mm aortic aneurysm 10 years previously at our center. An Anaconda fenestrated endograft (Terumo Medical Corp, Tokyo, Japan) with three fenestrations (both renal arteries and the superior mesenteric artery) was performed satisfactorily. The proximal diameter of the device was 34 mm, and the total length was 160 mm. The visceral stents used were Advanta stents (Getinge, Gothenburg, Switzerland).

During the follow-up period, the computed tomography scans had not shown any endoleaks, although noticeable and continuous degeneration of the aortic neck and suprarenal aorta had been seen. Finally, at 10 years after the first surgery, complete loss of the Anaconda proximal valleys, with distal migration of the prosthesis, and a proximal type I endoleak were noted. The aortic sac had enlarged by 10 mm within 6 months (Fig 1, *A*).

Because of the patient's age of 72 years and his comorbidities, which included ischemic heart disease and moderate chronic obstructive pulmonary disease, we chose the endovascular approach as the first option. Our initial approach was to perform a proximal extension to the previous repair with a new fenestrated endograft. However, the short bifurcated body of the Anaconda stent graft did not guarantee a good seal distally. Thus, we decided to use a Zenith custom-made endograft (Cook Medical, Bloomington, Ind) with four branches and a bifurcated body with an inverted contralateral limb (Fig 1, *B*).

Usually, performance of a branched endograft involves deployment of the endograft ∼10 mm above the ostium of the target vessel. In the present patient, we had planned to deploy both renal and superior mesenteric artery branches 21 mm and 24 mm above the respective ostium to complete deployment of the bifurcated body. In addition, the use of a bifurcated body with an inverted contralateral limb avoided the use of an aorto-uni-iliac

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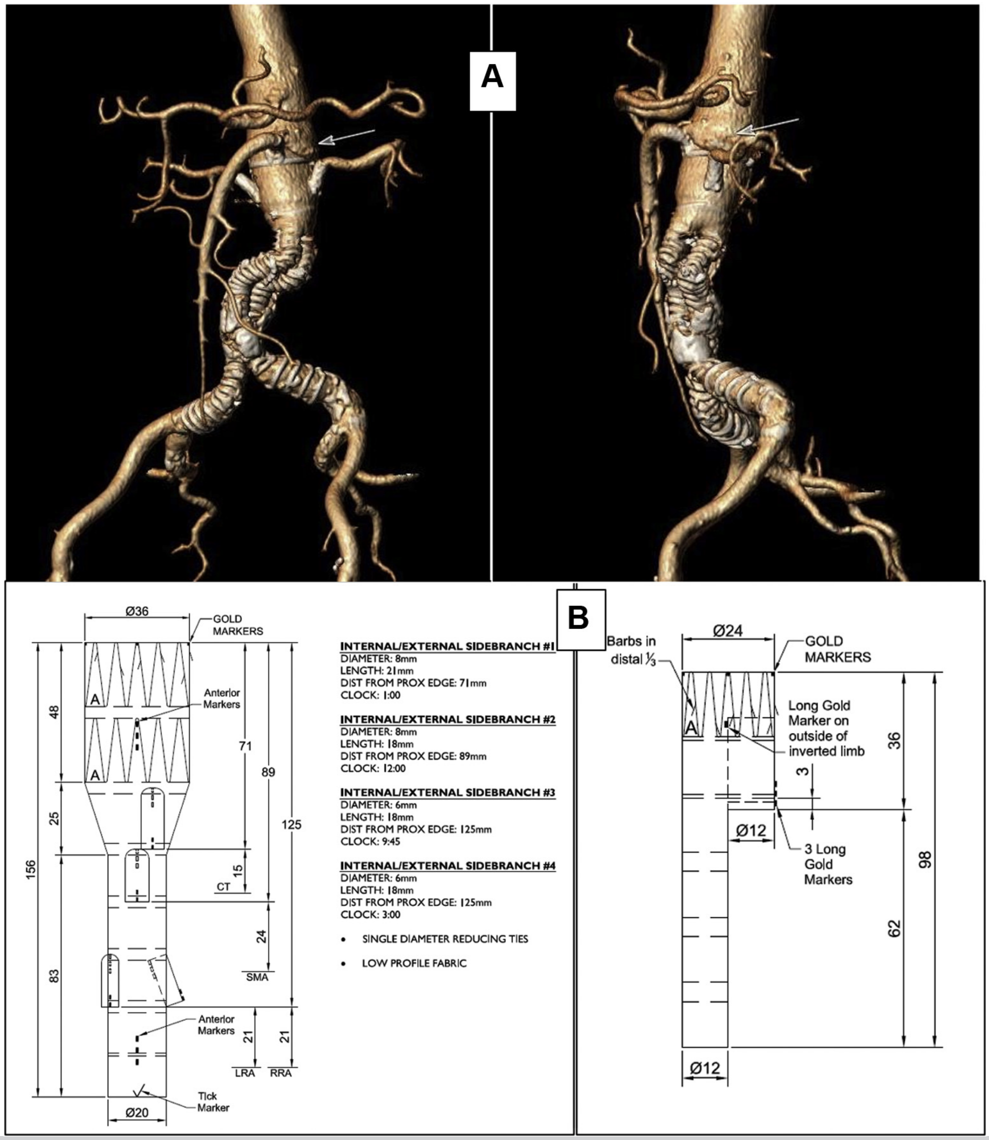

Fig 1. A, Three-dimensional reconstruction of 10-year follow-up computed tomography scan showing distal migration of the previous device, severe angulation of the renal stents, and a proximal type I endoleak (*arrow*). **B,** Case planning for a branched endograft and bifurcated body with an inverted contralateral limb.

device by gaining 4 cm in length. The branched endograft included single-diameter reducing ties and bifurcated body and was manufactured of low profile material allowing it to be loaded into a 20F introducer.

We had had two main concerns during the planning for the present case:

1. The extreme angulation of the two previous renal stents, which would make it challenging to cannulate these vessels from an axillary approach.
2. The scarce space available to maneuver between both devices once the branched component had been deployed.

Surgical procedure. The procedure was performed with the patient under general anesthesia. Percutaneous bilateral femoral access was established. Two ProGlide devices (Abbott Vascular, Santa Clara, Calif) and sutures were deployed for each femoral puncture. The surgical approach for the left axillary artery was used for proximal cannulation of the branches.

Deployment of the branched endograft and bifurcated body was performed through the right femoral access. A Check-Flo 20F- × 25-cm introducer (Cook Medical) was inserted into the left femoral artery for angiographic guidance and cannulation of the Anaconda stents (Terumo Medical), if necessary.

To ensure upper access to the custom-made graft, a through and through technique was used with a brachiofemoral approach using a Clover Snare Loop (Cook Medical). A 12- × 45-cm Flexor Introducer (Cook Medical)

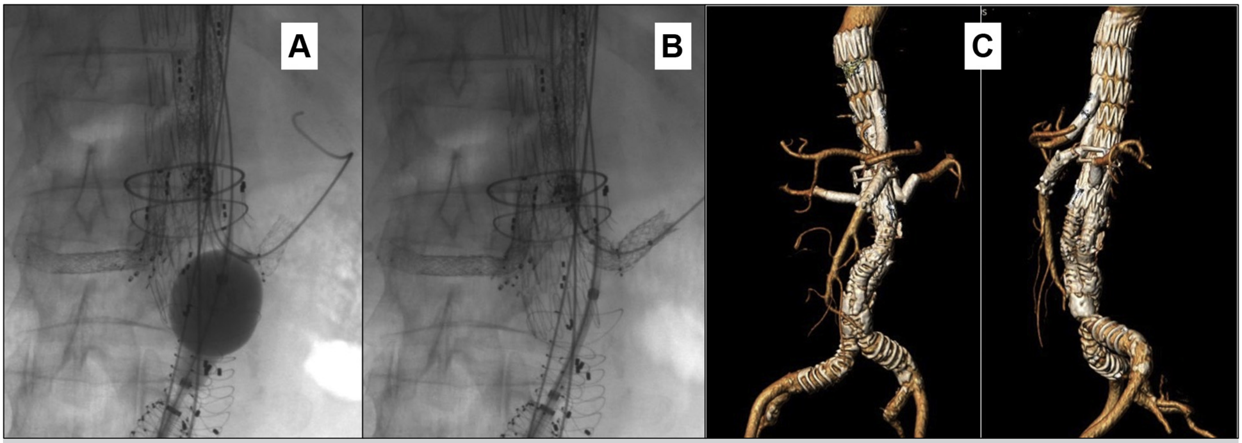

Fig 2. **A,** Imaging study after deployment of the right renal stent showing the use of the Coda Balloon (Cook Medical) to exchange the guidewire in the left renal artery. **B,** BeGraft Plus stent (Bentley Innomed GmbH) deployment in the left renal branch with no improvement of the previous angulation. **C,** Three-dimensional reconstruction of the 2-year follow-up computed tomography scan showing patency of all branches and extreme angulation of the left renal BeGraft Plus stent (Bentley Innomed GmbH).

was then advanced, with stability through the left axillary approach over an hydrophilic guidewire.

A 6.5F- × 90-cm Tourguide steerable introducer (Medtronic, Santa Rosa, Calif) with a 9-mm steerable area was used to catheterize the visceral stents via the axillary approach. The celiac trunk and superior mesenteric artery were catheterized without any issues. The BeGraft Plus 9- × 57-mm stents (Bentley Innomed GmbH, Hechingen, Germany) were deployed in both cases as bridging stents over the Rosen guidewire.

For cannulation of the right renal artery, it was necessary to increase the space between both devices to provide for maneuverability. Using the left femoral approach, we cannulated the right renal artery between both endografts. The exchange of the guidewire for greater support permitted the use of a 32-mm Coda Balloon (Cook Medical), which was inflated to provide the necessary space to catheterize the vessel. With this maneuver and the stability provided by the Tourguide steerable introducer (Medtronic), the exchange to a Rosen guidewire was possible. Finally, a 7- × 57-mm BeGraft Plus stent (Bentley Innomed GmbH) was deployed. Partial correction of the previous angle was achieved (Fig 2, *A*). The balloon maneuver duration was short; thus, the risk of distal ischemia was not increased.

The left renal artery was the greatest challenge of the surgery owing its great proximal angulation. Despite an attempt to rectify the severe angle of the vessel with an Amplatz guidewire (Boston Scientific, Boston, Mass) from the left femoral access, no improvement in the angulation was obtained. The steerable sheath allowed for catheterization of the vessel but did not provide enough support to exchange the guidewire for a stiffer wire. After numerous attempts, a 32-mm Coda Balloon (Cook Medical) via a femoral approach was inflated scant millimeters below the previous renal stent, which provided the necessary support (acting as an inferior stop) to advance the Rosen guidewire from the axillary approach (Fig 2, *A*). A 7- × 57-mm BeGraft Plus stent (Bentley Innomed GmbH) was deployed without any angle improvement (Fig 2, *B*).

Given that the Anaconda stent graft (Terumo Medical) has the bifurcation in the anteroposterior plane by default, it was necessary to deploy the bifurcated body with a 90° left lateral angulation. The proximal end of the bifurcated body was deployed a few millimeters below the ostium of the renal branches. Distally, 13-mm extensions were deployed bilaterally, achieving correct sealing over the previous 11-mm-diameter stents.

The final arteriogram showed patency of all the branches and no leaks. The case duration was 5 hours and 30 minutes, and the fluoroscopy time was 190 minutes (radiation dose, 38.295 cGy/cm^2). We used 210 mL of total contrast volume. At the 2-year follow-up computed tomography examination, all the branches remained patent, and the aortic diameter had been reduced by 2 cm (Fig 2, *C*).

DISCUSSION

A fenestrated graft implantation as a proximal extension of a failing fenestrated device has been previously described.[4] Although the use of branched devices is widespread, to the best of our knowledge, no study has reported the use of BEVAR after previous FEVAR. Challenging catheterization of the visceral arteries using a fenestrated endograft as a proximal extension of a previous EVAR has also been previously described.[5] In performing BEVAR after a FEVAR procedure, the lack of space between both devices will increase the difficulty of the procedure. In addition, in the present patient, the great difficulty was the distal migration that had occurred of the previous device, which had resulted in extreme angulation of the renal stents. The use of steerable introducers can be very useful for performing BEVAR using only a femoral approach only, as previously described.[6]

At present, no dedicated bridging stent graft is available for use for BEVAR.[7] Although the BeGraft stent (Bentley Innomed) has been studied for fenestrated endografts,[8] no studies supporting its use for branched devices have been performed. In our experience, the BeGraft Plus stent (Bentley Innomed) has shown excellent medium-term patency, even in the case of extreme anatomy, such as in our present patient.

Jain et al[9] previously described the utility of bifurcated grafts with inverted contralateral limbs in cases with a short length between the renal arteries and aortic bifurcation. In the present patient, its use allowed us to avoid the use of an aorto-uni-iliac device and extra-anatomic bypass.

CONCLUSION

BEVAR after previous FEVAR is a feasible technique, although it might require a large number of bailout techniques and should be performed in centers with experience in complex aortic endovascular treatment. Meticulous planning is mandatory to achieving good results.

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