

Tandem Endografts for Type II TAAAs

A fully customizable endovascular technique for treating thoracoabdominal aortic aneurysms in patients too high risk for open repair.

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This case report describes the first use of tandem abdominal aortic aneurysm (AAA) endografts for the management of a type II thoracoabdominal aortic aneurysm (TAAA). Currently, branched grafts are not approved by the US Food and Drug Administration and are not being tested in clinical trials in the United States. In patients with suitable anatomy, the tandem graft technique allows off-the-shelf use of AAA devices that have been approved by the US Food and Drug Administration to be used in treating TAAAs.

CASE REPORT

Patient History

A 74-year-old man presented with new-onset back pain. Workup revealed a 5.9-cm TAAA with an occluded celiac axis and right common iliac artery. The patient had significant chronic obstructive pulmonary disease and was on oxygen at home. He was not considered to be an open surgical candidate due to his chronic obstructive pulmonary disease. The aneurysm had a 5-cm-long neck distal to the left subclavian artery with a 27.5-mm neck diameter. The large thoracic component narrowed just above the renal arteries and redilated in the immediate infrarenal position. Therefore, his anatomy was not suitable for a thoracic and/or AAA endograft (Figure 1).

Treatment Plan

The plan for treatment was to place a 31-mm proximal diameter Excluder C3 device (Gore & Associates, Flagstaff, AZ) immediately distal to the left subclavian artery and extend distally with a second 23-mm proximal diameter Excluder. A transaxillary approach would be used to extend the Excluder limbs to the superior mesenteric artery (SMA) and then to the right renal artery with Viabahn grafts (Gore & Associates) (Figure 2). The left renal artery would be perfused from a retrograde right iliorenal endovascular bypass after recanalization of the occluded right common iliac

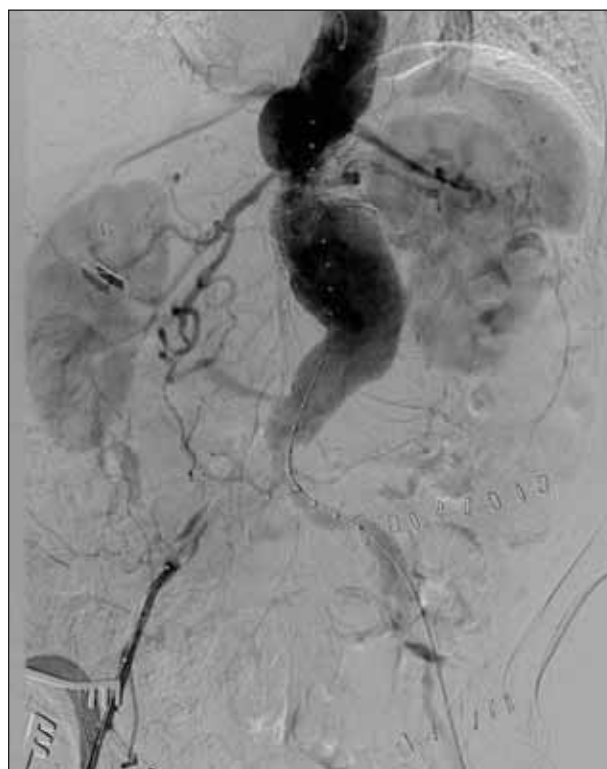


Figure 1. Diagnostic angiogram showing the dumbbell shaped TAAA with an occluded right common iliac artery.

artery. A left iliac conduit, required for device introduction, would be converted to a left-to-right iliofemoral bypass.

Procedure

The patient had a cerebrospinal fluid drain placed after induction of general anesthesia. Initially, a left retroperitoneal exposure was obtained, and an 8-mm Dacron graft was sewn to the common/external iliac junction. The left axillary artery was exposed in standard fashion, and a 6-mm Dacron conduit was sewn to it for subsequent 12-F sheath

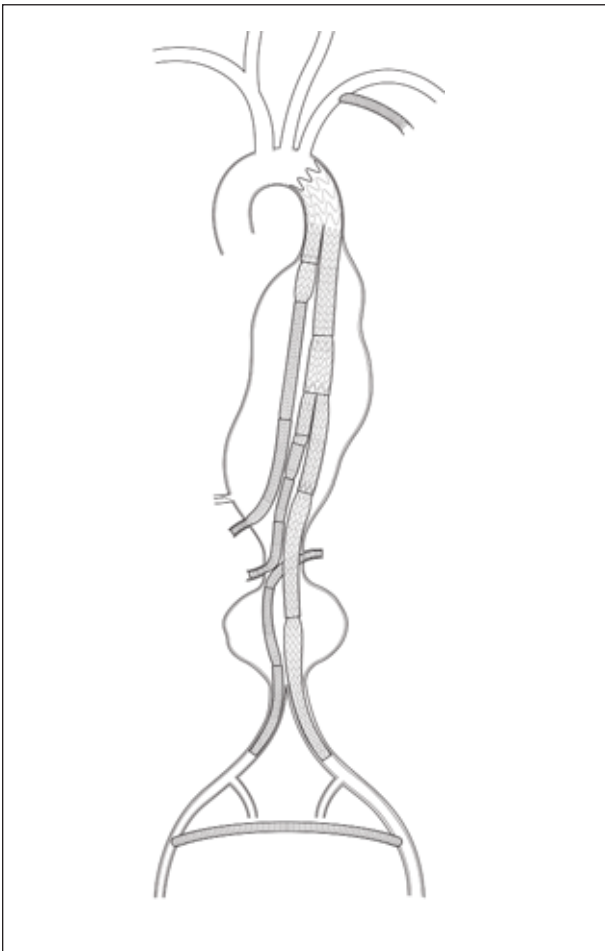


Figure 2. Depiction of the tandem endograft technique. Note the axillary conduit used for proximal graft cannulation. Excluder graft and limbs have larger stent struts compared to the smaller stent struts of the Viabahn grafts.

introduction. After administration of heparin, a 31-mm Excluder device was deployed just distal to the left subclavian artery via the iliac conduit. Subsequently, an 80-cm, 12-F sheath (Cook Medical, Bloomington, IN) was introduced over a stiff wire into the axillary conduit. The short gate of the thoracic-placed Excluder was cannulated from above, and a vertebral catheter was used to selectively cannulate the SMA. Angiography of the SMA showed excellent filling of the celiac axis via the gastroduodenal artery (Figure 3). A 10- X 10-mm Viabahn device was deployed in the SMA and extended proximally to the short gate with 12- X 10-mm and 13- X 10-mm Viabahn grafts, which had a 50% overlap for a secure seal and to avoid a delayed type III endoleak. We then dilated the Viabahn grafts distal to proximal with standard percutaneous transluminal angioplasty balloons to prevent component dislodgement from the artery.

Next, the ipsilateral limb of the Excluder was extended with a 20-mm Excluder limb from below. The 20-mm limb



Figure 3. Diagnostic angiogram of the SMA showing filling of the celiac axis. Note the 12-F proximal sheath placement from above and the constrained long limb of the Excluder, allowing for easier catheter and wire manipulation.

was used as the proximal landing zone for a 23-mm Excluder graft (Figure 2). The contralateral gate of the second Excluder was then cannulated from below and extended with a 10-mm Excluder limb. This was done to sufficiently taper the Excluder limb and facilitate the transition between the limb and the 5-mm renal artery (the contralateral gate of the Excluder device is 13 mm in diameter). Via the short limb of the second Excluder, the right renal artery was cannulated from above. The right renal artery was then extended to the proximal 10-mm Excluder limb with 6- X 10-mm, 8- X 10-mm, and 11- X 10-mm Viabahn grafts. The remaining long limb of the second Excluder was then extended to the left common iliac artery with appropriately sized limb extensions.

At this point, through a right femoral cutdown, the right common iliac artery was recanalized. We then cannulated the left renal artery from the right femoral approach and extended with Viabahn devices (6 X 10 mm, 8 X 10 mm,



Figure 4. Completion angiogram showing good flow to the visceral vessels with no endoleak. Note the retrograde right common iliac-to-left renal endoluminal bypass.

and 10 X 10 mm) from the renal artery to the common iliac artery (Figure 2). Angioplasty was performed at all endograft junctions from above or below as required. The left iliac conduit was subcutaneously tunneled across to the patient's right side and converted to a left-to-right iliofemoral bypass. A completion angiogram showed good flow to all visceral vessels with no endoleak (Figure 4).

Hospital Course and Follow-Up

The patient was extubated the next day and was kept in the intensive care unit for 48 hours to manage the spinal drain. He was discharged home on postoperative day 5. The patient had no neurological events. Three-month computed tomography showed no endoleaks (Figure 5), with patency of all visceral branches (Figure 6). The patient remains asymptomatic with return to preoperative functional status with creatinine at the baseline level of 1.3.

DISCUSSION

The morbidity and mortality rates for open TAAA repair remain very high in physiological high-risk patients. Unfortunately, branched grafts are not readily available for these patients in the United States. The few sites that have special access to these devices require customization with



Figure 5. Computed tomographic image showing no endoleak (A). Computed tomography was performed at the level of the left renal artery (B). Note the Viabahn device extending into the left renal artery and good flow into the SMA and right renal artery with the Viabahn device, as seen in each of these vessels on the cross-sectional images.

prolonged wait times. Additionally, fenestrated grafts have been shown to have unacceptable long-term complication rates, as seen in the only United States study involving renal branches with 4-year follow-up.^{1,2} Hence, it appears that mobile fenestrations or branched grafts may be the future of endograft therapy for TAAAs. The technique described in this case report allows for aneurysm thrombosis and remodeling, with the ability of the grafts to tolerate significant sac remodeling due to the 3- to 5-cm graft junction overlap. By comparison, with the current fenestrated technology (Cook Medical), the single circumferential point of contact between the visceral branches and the main body of the graft would be intolerant to even modest 2- to 3-mm graft migration.³ In a recent review of 107 patients treated with branched and fenestrated grafts who were followed for a mean of 25 months, 34 secondary procedures were performed in 28 (26.2%) patients.⁴ Type III endoleaks represented the most common cause for reintervention during follow-up. The investigators concluded that early and late



Figure 6. Three-dimensional reconstruction of 3-month follow-up computed tomography with no endoleak and good flow to all visceral vessels. The left-to-right iliofemoral bypass supplies the left kidney and the right leg.

complications requiring a secondary procedure after treatment with fenestrated or branched devices were not negligible, and secondary procedures performed for visceral vessel compromise had high rates of treatment failure. They stressed the need for significant device modification and caution widespread use of current fenestrated technology.

The ease of cannulation of the visceral vessels from above allows for use of devices that do not require customization. We have found that the visceral vessels are easy to cannulate if the distal end of the limbs are ≥ 2 cm above the target vessel. As all limbs from the main body of the graft point straight down, the need for customization to direct the limbs to the visceral target is not required (Figure 2). In the eight procedures performed to date with the current tandem or parallel graft technique, we have been able to cannulate all planned target vessels with minimal difficulty. The main disadvantage is the required length of coverage; there-

fore, it is best reserved for patients with true TAAAs requiring long segment coverage. This technique can also be used for larger proximal necks by the use of thoracic cuffs as proximal extensions. The C3 Excluder device remains partially constrained, allowing for easier gate cannulation and graft manipulation (Figure 3). With tandem or parallel endograft placement, for the first time in the United States, physicians will have the ability to use off-the-shelf devices to manage patients with TAAAs. ■

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GORE® EXCLUDER® AAA Endoprosthesis

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