# Innovative use of iliac branch device for repair of a type V thoracoabdominal aortic aneurysm

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## ABSTRACT

In this innovative technique case report, we describe the off-label use of an iliac branch endoprosthesis and a main body endovascular aneurysm repair component for total endovascular repair of a thoracoabdominal aortic aneurysm in a patient unsuitable for open repair. In the present report, we describe case planning and measurement techniques for this type of repair and postoperative considerations. The take-home lessons include the importance of advanced planning and the overall feasibility of this technique compared with other approaches, including the snorkel technique, in select patients. (J Vasc Surg Cases Innov Tech 2023;9:101247.)

**Keywords:** Complex endovascular aortic aneurysm repair; Iliac branch device; Mesenteric stenting; Thoracoabdominal aortic aneurysm

A 70-year-old man presented to our clinic with a 6.2-cm asymptomatic type V thoracoabdominal aortic aneurysm (TAAA).[1,2] He had coronary artery disease with a prior myocardial infarction. An echocardiogram and nuclear stress test showed a normal ejection fraction and no inducible ischemia. He was an active smoker with chronic obstructive pulmonary disease. He became short of breath with mild exertion. Pulmonary testing revealed a reduced forced expiratory volume in 1 second (1.8 L or 52% of the predicted value). He had chronic kidney disease (CKD), with a preoperative serum creatinine of 1.6 mg/dL and glomerular filtration rate of 43 mL/min (CKD stage 3b). Computed tomography angiography demonstrated his aneurysm originated at the level of T7, involved both the celiac artery (CA) and the superior mesenteric artery (SMA), and terminated just distal to level of the SMA. The diameter of the aorta just proximal and distal to the aneurysm was 31 mm. Given his age, CKD, and pulmonary disease, we discussed continued monitoring with no intervention vs endovascular repair as the best treatment options for this patient. He was not interested in traveling to centers involved in testing thoracoabdominal branched devices (investigational device exemption trial).[3] The patient provided written informed consent for the report of his case details and imaging studies.

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## TECHNICAL DETAILS

After a detailed evaluation of the anatomy and discussion of the treatment goals, we concluded that an innovative use of the Gore iliac branch endoprosthesis (IBE; W.L. Gore & Associates) was feasible and offered some benefits over alternative endovascular options. This IBE strategy entailed deployment of a standard 36-mm diameter abdominal aortic aneurysm (AAA) stent graft (Gore Excluder conformable AAA endoprosthesis) to obtain the proximal seal, with an IBE device and VBX stents for the CA (10 × 79 and 11 × 79 mm) and SMA (two 11 × 79-mm stents) and a flared iliac limb graft with a 36-mm diameter cuff to create the seal above the renal arteries. The VBX stents allow for overdilation for sealing in the IBE.

**Risks and benefits of IBE compared with snorkel strategy.** Compared with snorkeling, the IBE approach results in grafts supplying the CA and SMA for approximately one half the length, a slight decrease in the extent of aortic coverage, single vs bilateral arm access, and no risk of gutter leaks. The unfavorable aspects of this approach include intraluminal narrowing of the aorta to 14 mm and the novelty of the procedure.

**Preoperative planning.** A high-resolution computed tomography angiogram of the chest, abdomen, and pelvis was obtained (Fig 1). The diameter of the aorta and mesenteric vessels, length of the aneurysm, and the mesenteric vessel clock-face positions were obtained. Key measurements included the distance from the proximal seal zone to the mesenteric vessels to ensure adequate space to land the Excluder and IBE and allow for cannulation of the mesenteric vessels. We decided that landing the distal portion of the IBE >2 cm above the SMA would be adequate. We use preemptive lumbar drains in all patients we believe have higher risk features, which includes >20 cm aortic coverage, previous AAA

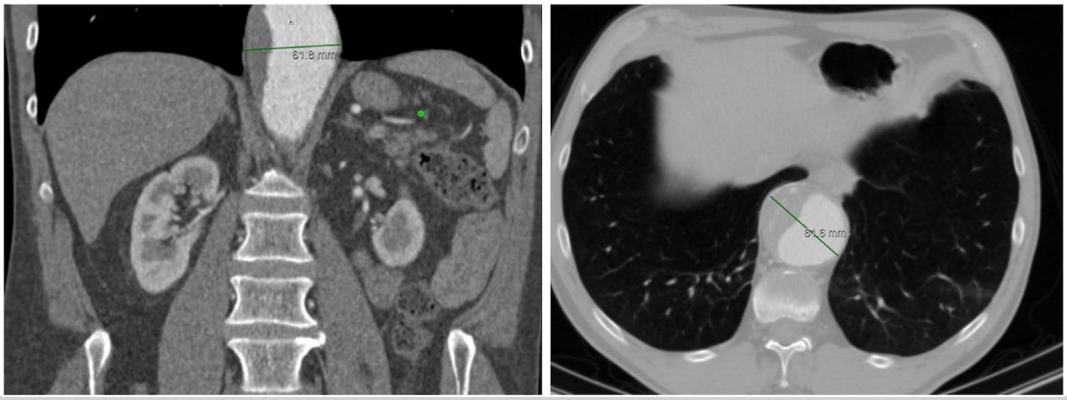

**Fig 1.** Preoperative computed tomography angiographic images of the patient's thoracoabdominal aortic aneurysm (TAAA).


**Fig 2.** Postoperative three-dimensional reconstruction images from the patient's 1-month postoperative computed tomography angiogram.

repair, subclavian artery coverage or occlusion, and internal iliac artery occlusion.

**Key intraoperative steps.** An arterial catheter, appropriate intravenous catheters, and a lumbar drain were placed preoperatively. Intraoperatively, 20F, 5F, and 8F sheaths were placed in the right common femoral artery, left common femoral artery, and left brachial artery, respectively. The Excluder, IBE, iliac limb, and cuff were deployed through the 20F sheath. The VBX stents for the CA and SMA (in that order) were placed through the 8F left brachial sheath. Angiography was performed through the 5F sheath. After confirming the locations with angiography and intravascular ultrasound, the proximal edge of the Excluder was deployed 19 cm superior to the proximal edge of the SMA, with the "contralateral" gate deployed anteriorly toward the SMA and CA origins. After cannulation of the contralateral gate via double-sticking the 20F sheath, the IBE was deployed with the shorter IBE limb placed at a slight obliquity to match the CA and the longer limb toward the SMA. We then cannulated the CA and SMA, sequentially, from the brachial access site. VBX stents sized for the CA and SMA were selected and deployed. VBX stents was selected instead of Viabahn stents to enable overdilation for sealing within the IBE device. In addition, the CA and SMA exited the aorta at favorable downward angles, suggesting the added flexibility that a Viabahn stent can

provide was not needed. A flared iliac limb (27 mm) was then deployed in the "ipsilateral limb" of the Excluder device to position it 3 cm above the highest renal artery. This positioning enabled adequate overlap with the iliac limb and adequate room for the cuff to expand to create the seal in the suprarenal aorta. The Excluder cuff (36 mm) was then deployed, landing at the highest renal artery. The patient had no significant intraoperative decrease in blood pressure, and cerebrospinal fluid (CSF) was drained slowly to obtain a CSF pressure of 10 cm $H_2O$ by the time aneurysm exclusion was obtained.

## POSTOPERATIVE CARE

The patient tolerated the procedure well and was extubated at the conclusion of the surgery and cared for in the intensive care unit. He was neurologically intact, and we elevated the lumbar drain pressure to 15 cm $H_2O$. He had excellent urinary output and demonstrated a return to his baseline renal function on postoperative day (POD) 1. On the evening of POD 0, he developed unilateral left leg numbness and weakness compared with the right (3 of 5 strength in all muscle groups below the left hip). The CSF pressure was decreased to 10 cm $H_2O$, the mean arterial pressure was maintained at >100 mm Hg, and we ensured his hemoglobin was >10 g/dL. His spinal cord ischemia (SCI) symptoms waxed and waned for ~36 hours until he regained normal motor and sensory function. We allowed his CSF pressure to slowly increase to 15 cm $H_2O$ before clamping the lumbar drain for 48 hours and then removing it. He was weaned off supplemental oxygen and worked with physical therapy. He was transferred to the ward on POD 5 and discharged home on POD 6. When he followed up in our clinic after 1 month, he had fully recovered and returned to his baseline level of activity, with no further neurologic deficits. Postoperative computed tomography angiography demonstrated no endoleak or stent compression (Fig 2).

## DISCUSSION

In this report, we describe the novel use of a standard AAA main body graft with an IBE device for endovascular repair of a type V TAAA. Our repair was technically successful with no evidence of a type I or III endoleak and with sustained perfusion to his CA, SMA, and renal arteries. This procedure has a risk of type IIIa endoleak, likely highest with the 36-mm extension cuff, given its short length. This risk was decreased by balancing the overlap with the flared iliac limb and allowing adequate room for expansion of the cuff outside the limb. As such, it was critical to land the flared limb adequately high above the renal arteries. Postoperatively, the patient had transient, unilateral SCI, although it is likely that his SCI risk would have been higher with open repair (secondary to an increased risk of hypotension during open repair) or a snorkel approach (secondary to increased aortic coverage that would have been needed for this patient).

The success of this case depended on extensive preoperative planning, including precise evaluation of the patient's anatomy and knowledge of the available endovascular devices and their lengths. We think that type V TAAAs might have anatomy favorable for this approach, particularly if an adequate seal zone is available above the renal arteries. However, a physician-modified cuff could accommodate the need for infrarenal sealing. In contrast, type IV TAAAs would not be amenable to this approach because the devices are too long. Narrowing of the aorta was one preoperative concern; however, postoperatively, the patient had no claudication and continued to have palpable pedal pulses in both feet.

## CONCLUSIONS

The use of a Gore Excluder endovascular aneurysm repair device with an IBE device and other adjunctive endovascular components (as described) could be a safe and effective method for repair of type V TAAAs.

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