The Sandwich Approach to TAAA Treatment

An innovative endovascular alternative for TAAA patients who are not candidates for open repair.

BY SCOTT M. DAMRAUER, MD, AND EDWARD Y. WOO, MD

The endovascular management of patients with thoracoabdominal aortic aneurysms (TAAAs) poses a significant challenge due to the lack of commercially available fenestrated or branched devices that allow stenting through the visceral segment, and outcomes reported from hybrid procedures have been disappointing.[1,2] In this case report, we describe the treatment of a patient with a type V TAAA using a "sandwich" technique with commercially available, off-the-shelf components.[3]

CASE REPORT

An 87-year-old man presented with a history of previous open infrarenal AAA repair, severe unreconstructable coronary artery disease, heart failure, chronic obstructive pulmonary disease, hypertension, and chronic renal insufficiency. He had originally presented to the emergency department at the age of 86 with severe lower abdominal and lower back pain. Computed tomographic angiography (CTA) demonstrated a 7.1-cm bilobed TAAA proximal to his graft and a distal 7.4-cm fusiform aneurysm between the graft and the aortic bifurcation. He underwent successful endovascular aneurysm repair (EVAR) with a Talent stent graft (Medtronic, Inc., Minneapolis, MN) for the distal aneurysm, which was believed to be symptomatic. He recovered well from this procedure, with resolution of his abdominal pain and was discharged on postoperative day 2.

Figure 1. A three-dimensional reconstruction of preoperative CT showing previous EVAR and a type V TAAA.

One month later, he was seen at follow-up with routine surveillance imaging that demonstrated excellent placement of his endograft, with no evidence of an endoleak.

At 1-year follow-up, the patient had successful exclusion of his distal aneurysm and sac regression. However, his type V TAAA had significantly enlarged. Now measuring 8 cm in size (Figure 1), the aneurysm was believed to be at significant risk of rupture. Due to his comorbidities, he was not a candidate for open repair. Given the proximal extent of his aneurysm, as well as his previous repair, the patient was likewise not a candidate for any of the fenestrated devices undergoing clinical trials. The option of endografting with sandwich stents to the branch vessels was offered.

The patient underwent somatosensory-evoked potential monitoring and placement of a spinal drain. Access was achieved via the bilateral common femoral arteries and the right axillary artery due to a pacemaker in the left infraclavicular space. In the first part of the sandwich technique, a Talent thoracic endograft was placed from the mid-descending thoracic aorta to within 2 cm of the superior mesenteric artery (SMA). A tapered endograft was used in this position to reduce the overall diameter from the initial seal zone of 42 mm to 38 mm at the visceral segment. The SMA and renal arteries were then accessed via the right axillary artery with three offset punctures. Each vessel

Figure 2. Intraoperative fluoroscopy demonstrating the use of a large balloon to provide counterpressure to prevent the wires and catheters from "pushing out" during cannulation of the left renal artery.

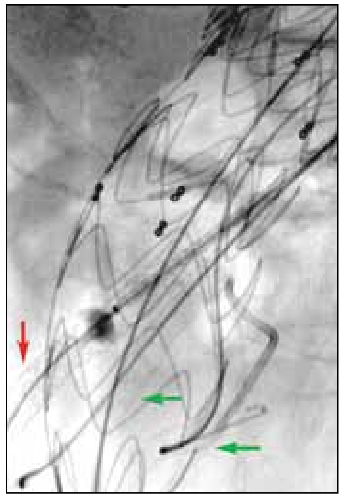

Figure 3. Intraoperative fluoroscopy showing final deployment of the sandwich construct with SMA (red arrow) and renal artery (green arrow) stents.

Figure 4. Early follow-up CTA demonstrating visceral snorkels (green arrow) sandwiched between the inner (red arrow) and outer (blue arrow) main body components.

was cannulated with a catheter and Glidewire (Terumo Interventional Systems, Inc., Somerset, NJ), and a 7-F sheath was tracked over a stiff wire to maintain access. Because the renal arteries were in the largest segment of the aneurysmal aorta, cannulation was difficult. For the left renal artery, a large balloon was inflated distally and was used to provide counterpressure to prevent the wires and catheters from "pushing out" and refluxing into the infrarenal aorta (Figure 2).

Once SMA and renal artery access was achieved, the sandwich graft was constructed. Viabahn endoprostheses (Gore & Associates, Flagstaff, AZ) were placed in each renal artery due to the length needed, and an iCast covered stent (Atrium Medical Corporation, Hudson, NH) was placed in the SMA. No stents were deployed at this time. A Talent thoracic endograft was then positioned with appropriate overlap into the previously deployed thoracic component for the proximal seal. The distal seal was achieved in the proximal main body of the previously placed AAA stent graft. The endograft was then deployed with subsequent expansion of all branch stents. The SMA graft extended proximally through the sandwich with two additional successive iCast covered stents; both renal stents were also extended with Viabahn endoprostheses.

The endograft was ballooned in the proximal segment while also ballooning the branch stents to allow maximal endograft apposition without crushing the branch stents. The junction of the thoracic stent graft and the abdominal stent graft was then ballooned for a distal seal. The final construct is shown in Figure 3.

Completion angiography was performed and demonstrated excellent flow throughout the aorta, as well as into both renal arteries and the SMA. The celiac artery filled retrograde via the gastroduodenal artery as planned. The patient's postoperative course was unremarkable, and a follow-up CTA at 1 month demonstrated excellent placement of all stent grafts and complete exclusion of the aneurysm (Figures 4 and 5).

DISCUSSION

The open management of TAAA carries with it significant morbidity and mortality, even in selected series from high-volume centers and surgeons.[4-6] In patients such as the one we described, who at baseline are not good operative candidates, the perioperative mortality becomes prohibitive. Unfortunately, there is no currently available, US Food and Drug Administration–approved endovascular device for treating these aneurysms. Hybrid approaches have been described involving open revascularization of the visceral and renal arterial branches from an uninvolved aortic segment with concomitant or delayed endovascular exclusion of the aortic aneurysm; however, results from this approach have been disappointing.[1,2]

This patient clearly could not tolerate an open repair given his advanced age and medical comorbidities. The combined use of standard abdominal and thoracic aortic stent grafts to exclude the aneurysm and smaller covered stents to revascularize the visceral arteries has been described in small series as either a "chimney" or

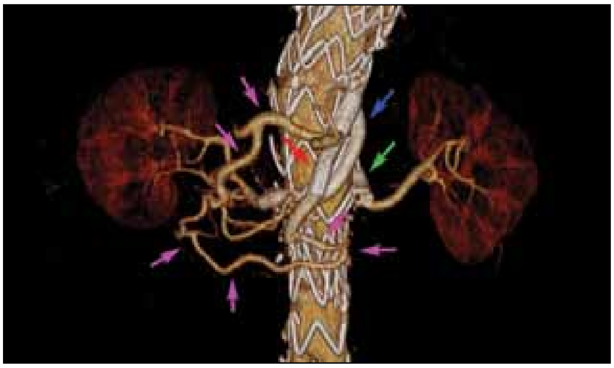

Figure 5. A three-dimensional reconstruction of early follow-up CTA. The SMA (red arrow), left (green arrow), and right (blue arrow) renal artery stents are in the appropriate positions. The celiac artery branches are reconstituted by collaterals from the SMA circulation via the gastroduodenal artery (magenta arrows).

"snorkel" approach.[7-9] In this case, the visceral stent grafts were sandwiched through the overlap between the distal thoracic aortic stent graft and the proximal abdominal component with their openings pointing craniad.[3] A standard snorkel procedure would require the branch stents to traverse up to the midthoracic aorta and increase the risk for branch vessel occlusion. As a result, the first endograft creates a landing zone in much closer proximity to the branch vessels, allowing for shorter stents.

The decision of which vessels to revascularize with snorkels depends on both anatomic and technical considerations. Assuming that the patient is not hemodialysis dependent, an attempt to snorkel into both renal arteries should be made. This can be complicated when the renal arteries are stenotic, upward directing, or tortuous. It is also difficult if the aorta is significantly aneurysmal at this segment. If the SMA is to be covered, this requires revascularization as well. As in this case, however, the celiac trunk can be occluded as long as there is clear evidence of collateralization via the gastroduodenal artery on preoperative CTA. This has been demonstrated in the experience with thoracic EVAR and celiac artery coverage.[10,11] In practice, the fewer snorkel grafts needed, the simpler the procedure and the greater the chance of technical success.

Due to the multiple components and the need to simultaneously deploy them, access must be achieved in both femoral arteries as well as the axillary artery. When three or fewer snorkels are to be used, the axillary artery can be directly accessed, and a conduit is unnecessary. Because of access concerns, patients with iliofemoral occlusive disease, or simply small arteries, may not be candidates. Likewise, patients with aberrant aortic arch anatomy, tortuous thoracic aortas, or those with type II and type III arch configurations present an increased technical challenge with respect to transaxillary selection of the visceral vessels. The case presented here had yet another technical challenge: tortuosity and angulation in the visceral segment, most notably with respect to selection of the renal arteries.

CONCLUSION

Despite the fact that the sandwich stent graft approach allows for the endovascular treatment of TAAAs, the procedure itself is extremely challenging and quite cumbersome. Many of the technical challenges inherent in this approach would be rendered moot by a branched or fenestrated endograft designed for TAAAs. As these devices are still not available in the United States, the sandwich technique offers a viable alternative for the endovascular treatment of TAAAs using commercially available, off-the-shelf components. ■

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