Modified deployment technique of off-the-shelf Gore thoracoabdominal multibranch endoprosthesis for post-dissection thoracoabdominal aortic aneurysm repair

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ABSTRACT

The Thoracoabdominal Multibranch Endoprosthesis (TAMBE) is a commercially available off-the-shelf four-vessel inner branched endograft for complex abdominal and thoracoabdominal aortic aneurysms. As post-dissection thoracoabdominal aortic aneurysms (PD-TAAAs) were excluded from the pivotal trials, there is paucity of data on the use of TAMBE in PD-TAAAs. Here, we present a case demonstrating the feasibility of TAMBE in conjunction with iliac branch endoprosthesis to repair PD-TAAAs, with focus on the deployment technique specific to PD-TAAAs. (J Vasc Surg Cases Innov Tech 2024;10:101632.)

Keywords: Complex abdominal aortic aneurysms; Fenestrated branched endovascular aortic repair (FBEVAR); Iliac branch endoprosthesis (IBE); Off-the-shelf multi-branched stent grafts; Post-dissection thoracoabdominal aortic aneurysm (PD-TAAA); Thoracoabdominal Multibranched Endoprosthesis (TAMBE)

The Thoracoabdominal Multibranch Endoprosthesis (TAMBE, W.L. Gore & Associates) is the first dedicated off-the-shelf four-vessel branched endograft to receive commercial approval from the United States Food and Drug Administration. Fenestrated branched endovascular aortic repair (FBEVAR) using the off-the-shelf TAMBE device has shown to be safe and effective for thoracoabdominal aortic aneurysm (TAAA).[1,2] Beyond the pathologies included in the investigational device exemption studies, TAMBE has also addressed type 1A endoleak from previous infrarenal endovascular aortic repair (EVAR) devices.[3] Despite the expanding adoption of thoracic endovascular aortic repair (TEVAR) in aortic dissections, residual thoracoabdominal dissections carry increased risk of aneurysmal degeneration.[4] FBEVAR has shown promising results for post-dissection thoracoabdominal aortic aneurysms (PD-TAAAs).[5] No report exists where TAMBE was utilized to repair PD-TAAAs. Here, we present a case that demonstrates the feasibility of TAMBE, with distal iliac extension with iliac branch endoprosthesis (IBE). Patient provided a written consent for publication. This case report was reviewed and determined to be exempt from Institutional Review Board Approval.

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CASE/TECHNIQUE

A 62-year-old male with history of hypertension, hyperlipidemia, morbid obesity, and type A aortic dissection repair 4 years prior was referred to our center with expanding 5.7-cm extent II post-dissection TAAA with concomitant bilateral common iliac artery aneurysms. The patient underwent zone 3 to 5 TEVAR as the first stage repair 6 weeks prior (Fig 1). Given the history of previous TEVAR and type A aortic dissection repair, concomitant FBEVAR with TAMBE and left IBE was planned. Following coil embolization of an enlarged inferior mesenteric artery, the true lumen was catheterized from bilateral femoral access. A 12 Fr $\times$ 45 cm Dryseal sheath (W.L. Gore & Associates) was introduced into the descending thoracic aorta from the brachial access. A 22 Fr sheath was advanced into position from the left femoral approach. Left brachial to left femoral through-and-through wire was achieved using an endovascular snare. Using a trilumen catheter (W.L. Gore & Associates), five through-and-through wires were established. Under fusion guidance, the preloaded 37-mm TAMBE main body was advanced with the portals above the target vessels (Fig 2, *A*). Following the first-stage TAMBE deployment, the celiac artery, superior mesenteric artery (SMA), and renal arteries were sequentially catheterized, leveraging the preloaded wire system from the brachial approach (Fig 2, *B*). Then, the TAMBE device was fully deployed and balloon-molded along the entire length

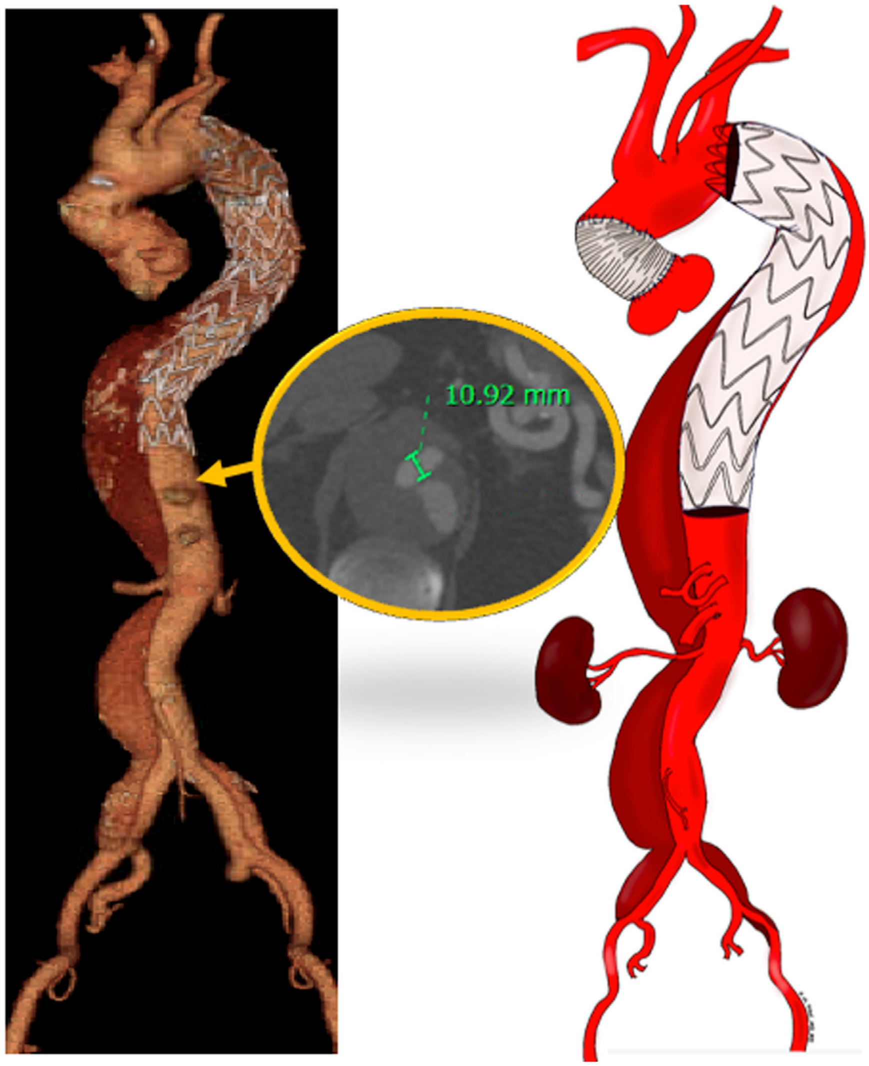

Fig 1. Patient underwent zone 3 to 5 thoracic endovascular aortic aneurysm repair (TEVAR) as the first stage repair 6 weeks prior with persistently compressed true lumen at the visceral segment.

to expand the true lumen (Fig 2, *B*). Bridging stents were placed sequentially using 7 × 29 mm VBX for the renal arteries, 10 × 79 mm VBX for the SMA, and 10 × 39 mm VBX for the celiac artery (Fig 2, *C*). The distal bifurcated component was then deployed. Although the false lumen extended down to the right common iliac artery, there was no re-entry tear. Thus, we elected to deploy a bell-bottom iliac limb on the right common iliac artery, instead of IBE. Then, a 20 mm bell-bottom iliac limb was deployed into the left common iliac artery. A trilumen catheter was used to achieve an additional left brachial to femoral through-and-through wire. A 23 mm × 14 mm × 10 cm IBE device was preloaded over the two through-and-through wires, then deployed down to the hypogastric gate. The hypogastric gate was accessed by advancing a 90-cm sheath from the brachial approach, then a buddy catheter was used to cannulate the left hypogastric artery. A 13 mm × 5 cm Viabahn was used as the hypogastric branch component. Total operative time was 540 minutes with fluoroscopy time of 61 minutes, and dose area product was 70,447 Gy^2/cm^3 with contrast usage of 165 mL. Patient had an uneventful recovery and was discharged home on postoperative day 3. At 3-month follow-up, the patient remains well with successful repair on computed tomography angiography (Fig 3).

DISCUSSION

Off-the-shelf multibranched thoracoabdominal stent grafts such as TAMBE have been shown to be suitable for urgent repair of symptomatic or large TAAA.[6,7] However, given the novelty of the TAMBE device, limited

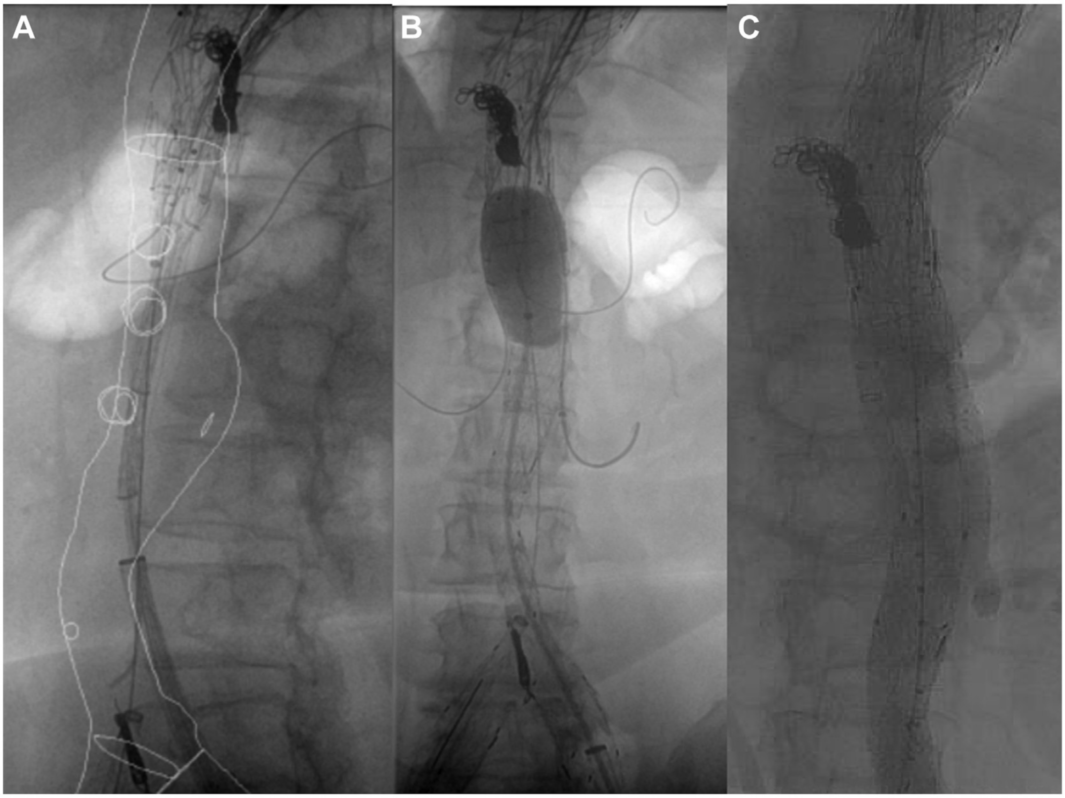

Fig 2. A 5.7-cm extent II thoracic aortic abdominal aneurysm (TAAA) with prior zone 3 to 5 thoracic endovascular aortic aneurysm repair (TEVAR). Thoracoabdominal Multibranch Endoprosthesis (TAMBE) main body was advanced with portals above target vessels advanced with the portals above the target vessels **(A)**. The celiac artery, superior mesenteric artery (SMA), and renal arteries were then subsequentially catheterized, and the TAMBE device was fully deployed and balloon-molded along the entire length to expand the true lumen **(B)**. Bridging stents were placed sequentially for the renal arteries, SMA, and celiac artery **(C)**.

literature exists regarding the suitability of TAMBE in post-dissection TAAA, as well as its use in conjunction with other branched prosthesis devices such as IBE. Expanded use of TAMBE beyond its instructions for use has allowed a repair of type 1A endoleaks from previous infrarenal EVAR devices.[3] Our report adds to the literature by demonstrating the feasibility of utilizing TAMBE in conjunction with IBE to repair post-dissection TAAA with concomitant common iliac artery aneurysms.

Chronic aortic dissections involving the thoracoabdominal aorta can degenerate into aneurysm over time distal to the previous open or endovascular repair.[8] In these patients, FBEVAR provides a less invasive treatment option with promising short to mid-term outcomes.[1] Despite the growing evidence supporting the safety and efficacy of FBEVAR in post-dissection TAAA, access to manufactured fenestrated branched endografts has been limited in the United States until recently. Our experience with PMEG in PD-TAAA has shown safe outcomes with high technical success.[9] TAMBE is the first four-vessel multibranched endograft to obtain United States Food and Drug Administration approval for the thoracoabdominal space. As such, centers including ours are rapidly accumulating their experience with TAMBE.

An important modification of TAMBE implantation steps should be noted in dissections. Without the use of adjunctive maneuvers such as septectomy, the true lumen frequently remains compressed. The instructions for use deployment steps of TAMBE involve placing the bridging VBX stents prior to full deployment of the main body. In the case of a compressed true lumen, this would result in persistently compressed true lumen at the branch bearing segment of the TAMBE device, and balloon-molding this segment to expand the true lumen after the VBX branch deployment carries the risk of compressing the bridging stents (Fig 4). Therefore, our modified steps involve full deployment of TAMBE main body and balloon molding along its entire length prior to the branch stent deployment. This ensures full

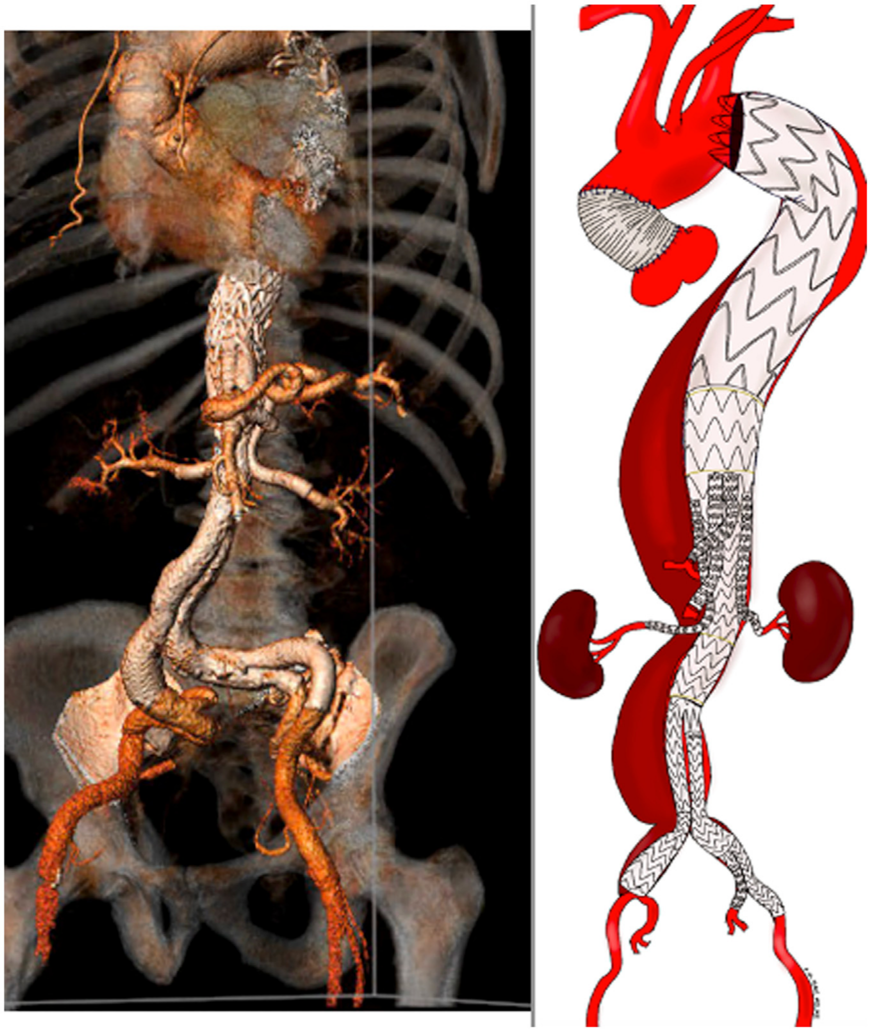

Fig 3. Computed tomography angiography with three-dimensional reconstruction at 3-month follow-up and illustration showing aortic reconstruction with no evidence of endoleak.

expansion of the branch bearing segment of the TAMBE main body. Although dissection propagation into the branch vessels during balloon expansion of the aortic is possible, branch cannulation is already performed with support wires secured prior to this step. This is a common step performed during FBEVAR using physician-modified endografts and custom-made devices, therefore not unique to TAMBE. However, what is unique to TAMBE is the longer distance from the inner branch portals to the target vessels, particularly the renal arteries. Potential risks of these modified implant steps include the main body device migration during multiple upper extremity sheath introductions through each of the portals, as well as difficulty tracking the sheath or bridging stents from the portal to the target vessel in a limited perigraft space (Fig 4). Meticulous attention to the sheath-to-main body interaction during these steps is critical to avoid these pitfalls. Adjunctive maneuvers such as balloon angioplasty should be used liberally to avoid placing undue force or tension on the TAMBE device.

CONCLUSION

TAMBE in conjunction with IBE can be safely utilized for endovascular repair of post-dissection TAAA. Further follow-up to assess aortic remodeling and long-term durability of this construct is planned.

DISCLOSURES

S.M.H. reports consultant for W.L. Gore and Associates, Cook Medical, Terumo, and Vestek; and is on the scientific advisory board for W.L. Gore and Associates and Vestek.

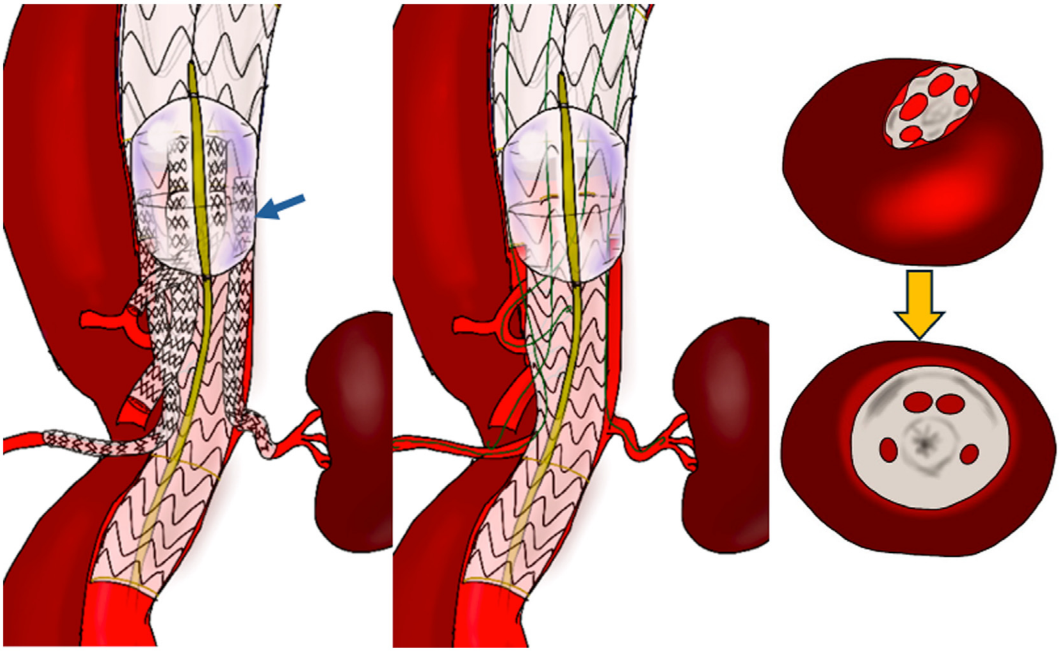

Fig 4. Following the instruction for use deployment sequence of Thoracoabdominal Multibranch Endoprosthesis (TAMBE) would result in inability to balloon open the branch-bearing segment of TAMBE in often compressed true lumen. Ballooning this segment would result in branch stent compression. The modified deployment steps involve full deployment of TAMBE following branch cannulation, and balloon-molding the entire length of TAMBE to expand the true lumen, prior to branch stent placement.

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