Gore TAG thoracic branch endograft for treatment of a subacute type B aortic dissection complicated by rupture

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ABSTRACT

An 80-year-old man presented with a subacute zone 3-5 type B aortic dissection complicated by rupture and visceral and lower extremity malperfusion. He underwent emergent zone 2 repair with a Gore TAG thoracic branch endograft with inclusion of the left subclavian artery for a dominant left vertebral artery. The patient's postoperative course was uncomplicated. Type B aortic dissections can be anatomically complex, and rupture is a rare complication in the subacute phase. We report the novel use of a Gore TAG thoracic branch endograft for the management of type B aortic dissection complicated by rupture and demonstrate its feasibility for patients with type B aortic dissection complicated by rupture. (J Vasc Surg Cases Innov Tech 2023;9:1-5.)

Keywords: Dissection; Endograft; Rupture; Thoracic branch endograft; Type B aortic dissection

Thoracic endovascular aortic repair (TEVAR) is the standard of care for acute complicated type B aortic dissection (TBAD).[1] Coverage of the left subclavian artery (LSA) is required to achieve a dissection-free proximal seal zone in 17% to 24% of cases.[2-4] In May 2022, the U.S. Food and Drug Administration (FDA) approved the Gore TAG thoracic branch endoprosthesis (TBE; W.L. Gore & Associates) as the first off-the-shelf, single-branch thoracic endoprosthesis for the treatment of aortic disease requiring zone 2 coverage. The device is indicated for the endovascular repair of lesions in the descending thoracic aorta with maintenance of flow into the LSA in select patients at high risk for left subclavian debranching procedures. Results from the TBE device studies demonstrated favorable safety and efficacy, with low mortality and reintervention rates ≤12 months after endovascular repair in patients with zone 2 aneurysms.[5-7] However, these studies did not include the outcomes of patients treated for acute or subacute complicated TBAD, and the safety and efficacy of the TBE device in this patient population have not yet been determined. We present the case of a patient with a subacute zone 3-5 TBAD complicated by rupture and visceral and lower extremity malperfusion, treated with the Gore TAG TBE. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

An 80-year-old man with subacute TBAD presented to our hospital with acute onset of tearing chest and abdominal pain radiating to his back. He had presented to an outside hospital 69 days before with an acute uncomplicated zone 3-5 TBAD secondary to hypertension and received medical management. No interval imaging was performed. The patient was a former smoker, and his medical history included chronic kidney disease stage IIIb, hypertension, hyperlipidemia, and type 2 diabetes. His surgical history included pancreaticoduodenectomy for pancreatic cancer 13 years before. On physical examination, the patient had significant dyspnea with signs and symptoms consistent with visceral and lower extremity malperfusion. He had severe, diffuse abdominal tenderness and Rutherford IIa acute limb ischemia of the bilateral lower extremities with nonpalpable femoral and pedal pulses. His creatinine was 4.5 mg/dL, up from his baseline of 2.0 mg/dL, suggesting concomitant renal ischemia. Computed tomography angiography of the chest, abdomen and pelvis confirmed a zone 3-5 TBAD with severe compression of the true lumen in zone 3 and hemothorax concerning for rupture (Fig 1). The distance from the LSA to the primary entry tear was 3 mm. The distance from the distal edge of the LSA to the distal edge of the left common carotid artery ostium was 17 mm. The diameter of the aorta at zones 1-2 was 39 mm, and the diameter of the supraceliac aorta was 34 mm. The patient's hematocrit was 15%; however, he was hemodynamically stable with a heart rate and systolic blood pressure in the range of 60 to 70 bpm and 100 to 120 mm Hg, respectively, with an esmolol infusion. The patient was emergently transferred to the hybrid operating room for TEVAR. Computed tomography angiography demonstrated a large, dominant left

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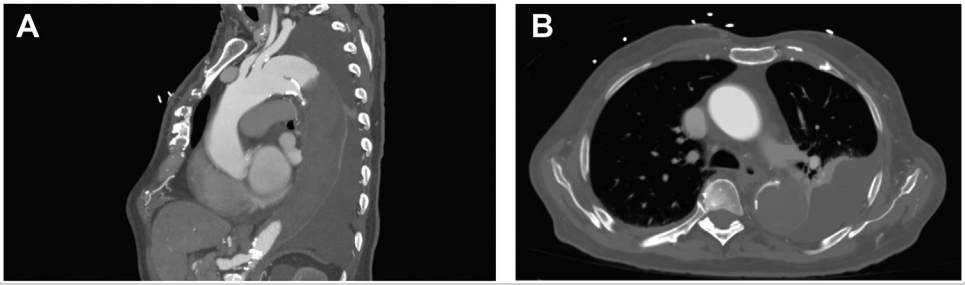

Fig 1. Complicated subacute zone 3-5 type B aortic dissection (TBAD) with left hemothorax and near occlusion of the true lumen, causing visceral and lower extremity ischemia in the sagittal (**A**) and axial (**B**) views.

vertebral artery with a diminutive right vertebral artery. Therefore, we planned to use the TBE to include the LSA in our emergent repair.

The patient underwent general endotracheal anesthesia. Ultrasound-guided access of the bilateral common femoral arteries was obtained. Three Perclose ProGlide sutures (Abbott Vascular) were placed in the right common femoral artery at the 10:00-, 12:00-, and 2:00-o'clock positions, and a 26F Gore Dry-Seal flex introducer sheath (W.L. Gore & Associates) was advanced into the visceral aorta. A 5F Pinnacle introducer sheath (Terumo Medical Corp) was placed in the left common femoral artery. Ultrasound-guided access of the left radial artery was obtained using 5F micropuncture access, and a Terumo stiff glidewire (Terumo Medical Corp) was advanced into the descending aorta. The left radial access with then upsized to a 5F × 90-cm Flexor Raabe guiding sheath (Cook Medical Inc), with the tip of the sheath placed in the proximal LSA. Glidewires were used to cannulate the ascending aorta from the right groin access. Intravascular ultrasound (IVUS) was performed from the right groin access to the ascending aorta to confirm true luminal placement of both the right femoral and the left radial wires. Through the IVUS catheter, the Glidewire was exchanged for a double-curved Lunderquist extra-stiff wire (Cook Medical Inc). However, on IVUS, collapse of the true lumen in zone 3 was found, and a mean 50-mm Hg gradient was noted between the left radial and right femoral access.

The Glidewire from the left radial artery access was snared from the right groin access over the Lunderquist wire using an Indy OTW vascular retriever (Cook Medical Inc) to create through-and-through wire access and reduce the risk of wire wrap. A 45-mm × 15-cm TBE with an 8-mm portal was loaded onto the Lunderquist wire, with the through-and-through Glidewire loaded through the 8-mm TBE portal. The TBE was placed in the aortic arch, ensuring the absence of wire wrap, and a pigtail catheter was advanced into the ascending aorta from the left groin access. Angiography was performed to confirm the origins of all arch vessels. The TBE was deployed just distal to the left common carotid artery. The time from vascular access to deployment of the TBE was 20 minutes. A 15-mm × 6-cm TBE side branch component was loaded over the through-and-through wire and brought through the TBE portal into the proximal LSA without difficulty. Selective angiography of the LSA was performed through the left radial sheath, which identified the origin of the left vertebral artery, and the TBE side branch was deployed from the TBE portal into the proximal LSA. Balloon angioplasty was performed of the portal overlap, distal stent, and mid-stent using a Gore molding and occlusion balloon (W.L. Gore & Associates). Arch angiography was performed and confirmed patency of the arch vessels and TBE with no endoleak (Fig 2). Because of the concern for rupture, we elected to extend our repair to zone 5 with a cTAG, 45-mm × 20-cm, stent graft (W.L. Gore & Associates). IVUS confirmed residual compression of the stent graft within the true lumen at zone 3, with a residual mean 30-mm Hg radial to femoral pressure gradient. No evidence of flow was found within the false lumen, and we believed this represented static compression. Balloon angioplasty of the TBE within zone 3 was performed with a Gore molding and occlusion balloon, resulting in resolution of the radial to femoral pressure gradient. A chest tube was placed within the left pleural cavity with the return of 1000 mL of blood. The patient awoke from the operation neurologically intact. He was transferred to the intensive care unit for serial neurologic monitoring. Our protocol for extensive thoracic aortic coverage includes the following parameters for the first 24 hours: mean arterial blood pressure >80 mm Hg, systolic blood pressure <160 mm Hg, hemoglobin >10 g/dL, platelets >100 × 10^3/μL, and fibrinogen >200 mg/dL. The patient's hospital course was uncomplicated, and his creatinine returned to a baseline of 2.0 mg/dL. The patient was discharged on postoperative day 6 and underwent a 30-day follow-up computed tomography scan without evidence of complications (Fig 3).

DISCUSSION

We report the case of a patient who presented with a subacute complicated TBAD. A significant proportion of patients with acute TBAD present with complications necessitating TEVAR >14 days after the onset of symptoms in the subacute phase (15-90 days).[8] Rupture is a rare complication of the subacute phase, with an incidence of only 0.8%.[9] On retrospective review, our patient had several risk factors for adverse events from the initial, acute presentation, including age >70 years,[10] aortic diameter >40 mm (43 mm),[11,12] false lumen diameter >22 mm (actual, 26 mm),[13] and partial false lumen thrombosis.[14]

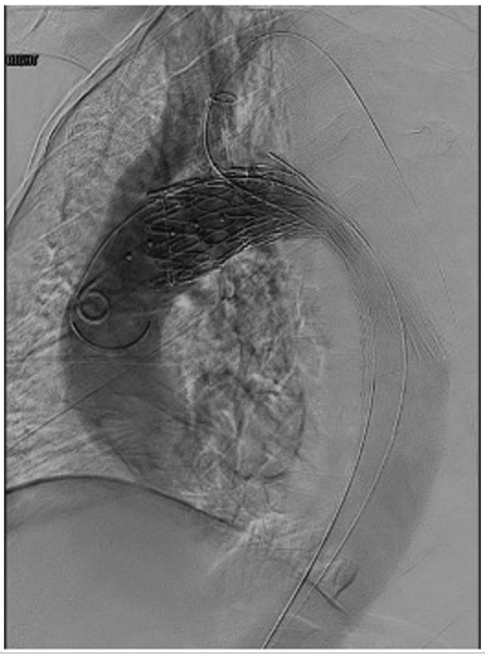

Fig 2. Imaging study after deployment of Gore thoracic branch endoprosthesis (TBE) with seal of the entry tear and aortic rupture and patency of the supra-aortic trunk, including the left subclavian branch.

TEVAR is the standard of care for acute complicated TBAD. Coverage of the LSA is often required to achieve a dissection-free proximal seal zone. Mesar et al[15] suggested that patients might benefit from a more aggressive proximal landing zone with similar perioperative morbidity when zone 2 TEVAR is done with LSA revascularization. Open debranching of the LSA will allow for more proximal coverage; however, it is not without complications. In the setting of rupture, debranching can delay the definitive seal of the rupture if performed before TEVAR and results in the risk of cerebral ischemia if performed after TEVAR.[16,17] FDA approval of the Gore TBE device offers the ability to perform total endovascular incorporation of the LSA during zone 2 TEVAR and will undoubtedly affect how vascular surgeons manage TBAD. However, the early reported results from the TBE device studies included only patients with zone 2 aneurysms and not patients treated for acute or subacute TBAD. Saito et al[18] were the first to demonstrate the feasibility of a single-branched stent graft for treating acute TBAD using the Inoue single-branched stent graft. However, the graft design was limited by the high rate of type I endoleaks (29%) in patients with chronic TBAD, likely secondary to the weak sealing ability of the ring configuration used by the stent graft.[18] A recent multicenter trial in China by Jing et al[19] demonstrated the feasibility of the Castor single branch stent graft (MicroPort Medical) in 50 patients with acute TBAD. They reported a technical success rate of 97%, a low rate of aortic-related events (3%), and no aortic-related mortality at a median follow-up of 61 months.[19] The Valiant Mona LSA (Medtronic) is the only other single branch stent graft under study in the United States.[20] To the best of our knowledge, this is the first report to demonstrate the safety and efficacy of the TBE for the treatment of subacute TBAD with the complications of rupture and malperfusion.

In the present patient, we elected to use a TBE for the treatment of a subacute TBAD complicated by rupture and malperfusion. The patient had a large, dominant left vertebral artery and a diminutive right vertebral artery. With incomplete imaging of the circle of Willis, we believed this was an indication for revascularization of the LSA. However, given the emergent setting and concern for rupture, we did not believe open debranching of the LSA was appropriate and would have delayed definitive seal of the rupture. Therefore, we elected to use a total endovascular approach. Primary troubleshooting with the TBE includes iliofemoral access, true lumen confirmation, management of wire wrap, and deployment of the side branch. Iliofemoral access is an essential consideration, because the mean aortic proximal landing

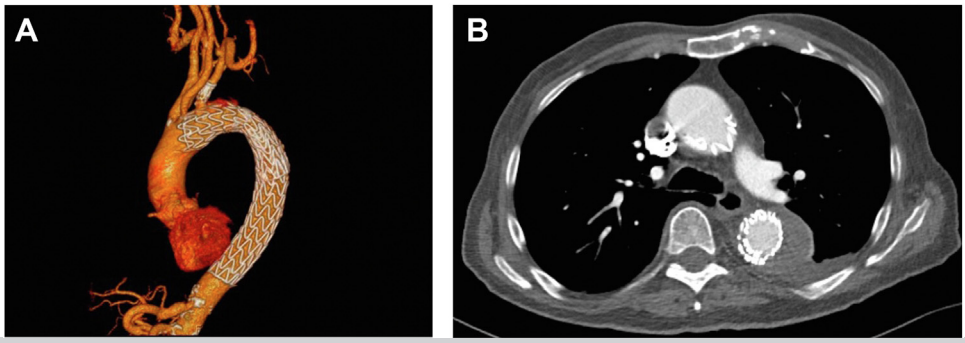

Fig 3. Imaging study at 30 days postoperatively demonstrating seal of the aortic dissection and expansion of the true lumen in the sagittal (**A**) and axial (**B**) views.

zone diameter was 35 ± 3 mm in a recent study of TBAD by Magee et al.[2] The TBE instructions for use recommend device diameters of 40 mm and 45 mm for the intended aortic diameters of 31 to 37 mm and 34 to 42 mm, respectively. The 40-mm and 45-mm diameter devices both require a 26F introducer sheath and might not be applicable to patients with small, calcified arteries. It is our practice to place three Perclose ProGlide sutures (Abbott Vascular) at the 10:00-, 12:00-, and 2:00-o'clock positions for the 26F introducer sheaths. True lumen access should be confirmed in every dissection case, for which we prefer to use IVUS. Tension should be maintained on the through-and-through wire while advancing the graft to maintain rotational alignment between the side-branch portal and the greater curve of the arch. Digital magnification is recommended to confirm the proper orientation, and the delivery catheter should be twisted in the descending aorta to undo any wire wrap. Finally, the side branch portal can often be malrotated or compressed within a narrow aortic lumen, making it difficult to cannulate. Two strategies we have found useful in this scenario are balloon angioplasty of the portal before introduction of the side branch component and crossing the portal retrograde with the upper extremity sheath to match the tip of the upper extremity sheath to the nose cone of the side branch to help guide it through the portal while advancing the side branch. Even with these potential difficulties, deployment of the TBE was straight forward in the present patient, with an operative time of only 20 minutes from access to the deployment of the TBE and seal of the rupture.

In the present case, we have demonstrated the feasibility of the TBE device for the emergent treatment of complicated TBAD with rupture and malperfusion. However, the device might not be universally applicable to all patients. The proximal covered length (measured from the distal edge of the LSA to the distal edge of the left common carotid artery ostium) must be ≥15 to 36 mm, depending on the aortic component selection. Magee et al[2] found that only 28% of patients with TBAD who required zone 2 TEVAR met all the anatomic requirements for this device and noted that future devices would need to consider the short distance between the left carotid artery and LSA to be more broadly applicable. The TBE device studies included additional cohorts of traumatic dissection and dissection, and greater knowledge is required regarding the feasibility and safety of the device for this population when those results are reported.[5-7]

CONCLUSIONS

Treatment of zone 2 aortic arch lesions is evolving with FDA approval of the Gore TAG TBE device. Our report of the novel use of a Gore TAG TBE device for the emergent management of complicated TBAD demonstrates its feasibility for this patient population. TBE performance in the emergent setting has great potential to benefit patients by offering rapid sealing of the rupture and maintaining LSA perfusion.

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