Thoracic branched endograft for traumatic aortic pseudoaneurysm

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ABSTRACT

Thoracic endovascular aortic repair is the standard treatment for blunt traumatic aortic injuries (BTAI). Approximately 40% of patients with BTAI require left subclavian artery (LSA) coverage for adequate proximal seal. Intentional LSA coverage is not benign; it is associated with complications including stroke, spinal cord ischemia, vertebrobasilar, and left arm ischemia. To avoid these devastating complications, LSA revascularization is recommended before elective zone II thoracic endovascular aortic repair, but is often omitted during emergent cases. We report two cases of aortic zone II traumatic grade III BTAI (aortic pseudoaneurysm) that we successfully treated with the GORE prior to TAG thoracic branch endoprosthesis. (J Vasc Surg Cases and Innovative Techniques 2019;5:540-3.)

Keywords: Thoracic branched endograft; Grade III aortic injury; Zone II; Pseudoaneurysm

Thoracic endovascular aortic repair (TEVAR) is indicated for the treatment of thoracic aortic aneurysms and blunt traumatic aortic injuries (BTAI) of the descending aorta, which commonly occur at the aortic isthmus.[1-6] Coverage of the left subclavian artery (LSA) is often required to achieve adequate proximal seal. This is frequently associated with challenges in determining the need for revascularization of the LSA in polytrauma patients. Current Society for Vascular Surgery and European Society for Vascular Surgery practice guidelines suggest selective preoperative revascularization for anatomically suitable patients undergoing zone II TEVAR with coverage of the LSA.[1,4] LSA coverage is associated with complications, including stroke, spinal cord ischemia, paraplegia, and vertebrobasilar and left arm ischemia.[2,3] Recently, branched endograft devices have been used to exclude proximal descending aneurysms while maintaining branch vessel perfusion. The option to perform LSA revascularization with an endovascular approach alleviates the concomitant risk of injuries to surrounding structures during open revascularization. The following cases demonstrate successful use of a GORE TAG thoracic branch endoprosthesis (TBE) (W. L. Gore & Associates, Inc., Flagstaff, Ariz) for a grade III BTAI. Patient consent was obtained for this report in both cases.

CASE REPORTS

A 29-year-old man was involved in a motor vehicle collision and presented to a tertiary care level I trauma center. On arrival, he was normotensive, with a Glasgow Coma Scale of 15. A computed tomographic angiogram of the chest showed a grade III BTAI 4 mm distal to the LSA (Fig 1) requiring zone II TEVAR. Associated injuries were right femur and acetabular fractures. Intracranial and upper extremity injuries were ruled out and there were no signs of active bleeding. The Injury Severity Score was 20. Given his age and hemodynamic stability, we decided to proceed with TEVAR with LSA revascularization using the investigational GORE TAG TBE and he was taken emergently for repair. Simultaneous bilateral percutaneous femoral and open left brachial artery access were obtained. A preclose technique[7] was used in the left femoral artery, followed by placement of a 20F introducer sheath. Systemic heparin was given to achieve an activated clotting time of greater than 200 seconds. An aortogram showed codominant vertebral arteries and a descending thoracic aortic pseudoaneurysm distal to the origin of the LSA, which was also confirmed by intravascular ultrasound examination. Both vertebral arteries were codominant. Through a 5F brachial artery sheath, an Advantage wire (Terumo Medical, Tokyo, Japan) was advanced into the descending thoracic aorta and snared through the groin to precannulate the branched device portal. The 26 × 26 × 10 mm aortic component was then advanced over a Lunderquist wire (Cook Medical, Inc., Bloomington, Ind). The aortic component and branch portal were aligned under fluoroscopy and were deployed just distal to the left common carotid artery. No additional maneuvers to avoid migration by wind-socket effect were required because through-and-through wire access stabilized the aortic component. LSA angiogram was obtained and a 12-mm branched graft was then advanced from the femoral approach and deployed in the LSA over the Advantage wire.

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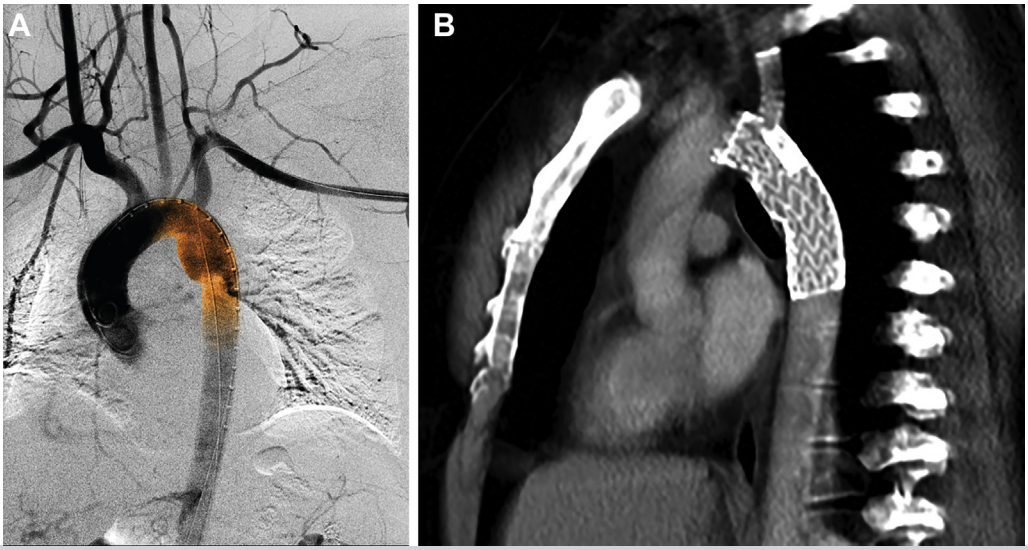

Fig 1. A, Intraoperative angiogram demonstrating aortic pseudoaneurysm (colored in orange) at zone II. **B,** Postoperative computed tomography angiogram showing deployment of GORE TAG thoracic branch endoprosthesis (TBE) in patient one at the 1-month follow-up.

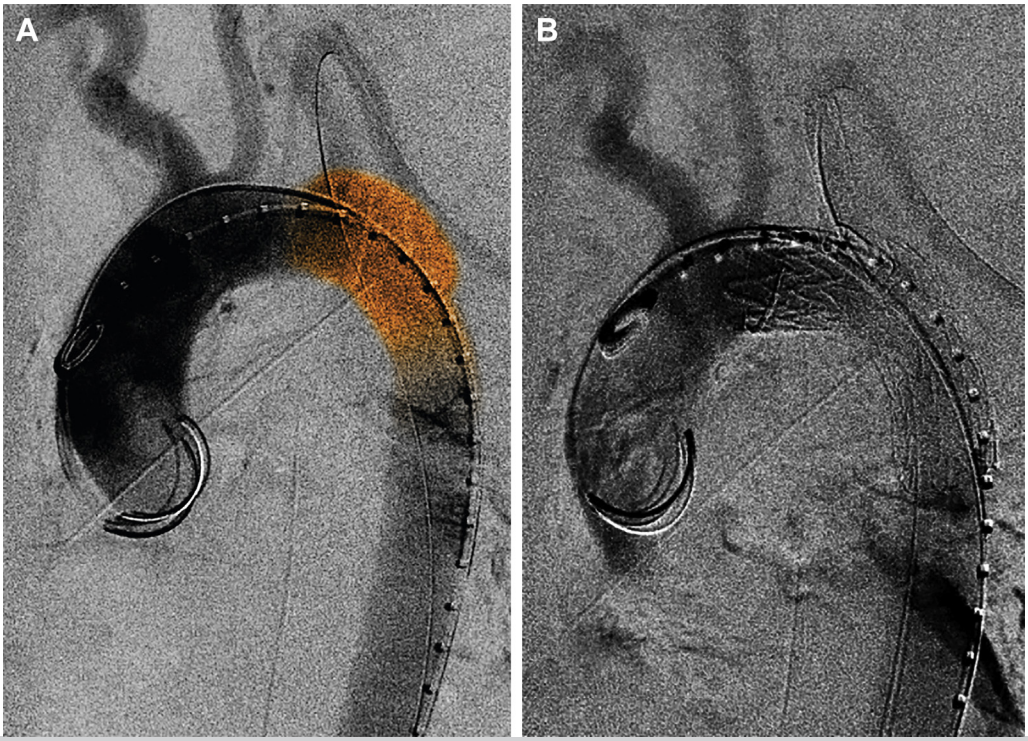

Fig 2. (A) Intraoperative angiogram demonstrating aortic pseudoaneurysm (colored in orange) at zone II before and **(B)** after GORE TAG thoracic branch endoprosthesis (TBE) deployment in patient two.

Completion angiogram revealed patent LSA and left vertebral arteries with pseudoaneurysm exclusion. Left brachial artery repair and closure were performed and the femoral sheath was removed. Operative time was 53 minutes and contrast dose was 35 mL. The patient had no neurologic deficit postoperatively and was discharged on postoperative day 11 after acetabular repair. The 1-month follow-up computed tomography scan demonstrated pseudoaneurysm exclusion without endoleak.

The subsequent patient is a 45-year-old man who presented after a motorcycle collision. Upon arrival, he was hemodynamically stable and his Glasgow Coma Scale was 8T. A chest radiograph

revealed bilateral hemopneumothorax, for which bilateral chest tubes were inserted. Chest computed tomographic angiogram showed a grade III BTAI (Fig 2) extending from the aortic isthmus to 3.3 cm caudally, 4.2 mm from the LSA origin, associated with mediastinal and periaortic hematoma. Other injuries included multiple bilateral rib fractures and left clavicular fracture. There were no intracranial or intra-abdominal injuries and no major sites of bleeding. His Injury Severity Score was 16. Operative steps as detailed were taken to deploy a 26 × 26 × main aortic component and a 12-mm branch component. Operative time was 49 minutes and contrast dose was 40 mL. He was neurologically intact postoperatively and follow-up imaging at 1 month demonstrated a patent aortic stent graft without endoleak.

DISCUSSION

BTAI remains the second leading cause of traumatic death, surpassed only by head injuries.[8] Commercially available endovascular devices are limited to treatment of aortic zones where no critical branch vessels are involved[9]; however, approximately 40% of patients with BTAI require LSA coverage for adequate proximal seal.[8] Current Society for Vascular Surgery guidelines recommend preoperative revascularization of the LSA for zone 2 TEVAR[3]; however, grade III injuries often do not allow for pre-TEVAR LSA revascularization, owing to their emergent nature. Morbidity and mortality associated with open LSA revascularization remain high in trauma patients.[1] Several studies have shown a clear benefit in favor of LSA revascularization to prevent posterior circulation territory stroke and spinal cord ischemia.[2,3] In emergent cases of zone II TEVAR where LSA coverage cannot be avoided, application of chimney and parallel endografts have been implemented as feasible bail-out procedures with reasonable midterm success.[10] Owing to forces unique to the distal arch and proximal descending thoracic aorta, stent patency, migration, collapse, and development of a type IA endoleak are concerns with such repair. Thus, a branched device constructed for this location could potentially alleviate the need for open bypass and avoid stent-related complications.

The GORE TAG TBE is a single-branch stent graft designed for the treatment of thoracic aortic aneurysms with intentional zones 0, I, and II proximal landing and is a promising device for use at our high-volume trauma center because it allows for rapid endovascular exclusion of distal arch pathology while maintaining perfusion to the LSA. Unstable patients and patients with less than 2 cm between the left common carotid artery and LSA, origin of the left vertebral artery within 20 mm of LSA, or a left vertebral artery originating from the aortic arch are not suitable candidates for this device.[11] Because femoral and brachial artery exposure with through-and-through wire before cannulation of the branch portal are performed simultaneously, the procedure can be completed expeditiously. Given the low incidence of paraplegia and spinal cord ischemia (3%) in the setting of BTAI, the risk of an epidural hematoma from lumbar drain placement in a coagulopathic polytrauma patient, as well as the short distance of aorta coverage with LSA preservation, no additional protective measures are taken other than avoiding hypotension during the procedure. It is our practice to insert a lumbar drain in the setting of postoperative neurologic deficits.

We emphasize that this is a novel device, which we have shown to be safe and effective for the treatment of traumatic grade III BTAI injuries where the proximal landing zone for standard TEVAR devices is not indicated and open revascularization of arch vessels can be avoided. This device remains in feasibility trials, with larger trials ongoing to evaluate their use in traumatic aortic injury. A larger patient cohort and long-term follow-up are needed to further characterize the safety and durability of this device.

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