Endovascular repair of a ruptured, extremely tortuous, descending thoracic aorta aneurysm with aortic coarctation

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ABSTRACT

We have presented a case of a ruptured descending aortic aneurysm that was accompanied by extreme tortuosity and a pseudocoarctation at the level of the ligamentum arteriosum. We performed successful endovascular repair, covering the left subclavian artery, using a transapical-to-femoral artery (through-and-through) guidewire technique to overcome the tortuosity, with the option to perform balloon angioplasty in the case of an increased gradient over the coarctation. In the present case report, we have underlined the role of close collaborations with aortic expertise centers. (J Vasc Surg Cases Innov Tech 2022;8:480-3.)

Keywords: Aortic coarctation; Descending thoracic aortic aneurysm; Endovascular repair; TEVAR; Tortuosity

A descending thoracic aortic aneurysm (TAA) is a potentially lethal disease with an annual risk of dissection or rupture of 3% to 7%.[1,2] Thoracic endovascular aortic repair (TEVAR) is an excellent approach for emergency repair, even in complicated cases with suboptimal anatomy. To contribute to the literature on these challenging cases, we have reported our endovascular approach for a ruptured, extremely tortuous TAA with aortic pseudocoarctation. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

A 67-year-old man with a history of dual-chamber pacing and a TAA (47 mm at 3 months before presentation) had presented with acute-onset thoracic pain. He was hemodynamically stable, with good cardiac function and palpable peripheral pulses. Computed tomography angiography (CTA) of the total aorta in the referring hospital revealed a rupture of the known TAA, with a tear flush distal to the left subclavian artery (LSA) and extensive subpleural and mediastinal hematoma (Fig 1). The proximal descending thoracic aorta was extremely tortuous and accompanied by a local narrowing, a pseudo-coarctation at the level of the ligamentum arteriosum. No additional aneurysms were detected within the CTA. The patient was immediately transferred to our aortic expertise center for emergency repair.

Owing to the involvement of the distal aortic arch, the proximal landing zone included the LSA (zone 2). Apart from open surgical repair, which requires deep hypothermic circulatory arrest, we considered covering the LSA via emergent TEVAR. The TEVAR would extend to ∼30 cm in length into the lower descending thoracic aorta. Without prior revascularization, the risk of spinal cord ischemia is increased. Cerebrospinal fluid drainage, however, would delay emergent intervention. Given the small left vertebral artery, cerebral flow is not at risk. However, the risk of left arm malperfusion is increased, necessitating immediate postoperative surgical revascularization.[3,4] Thus, we prepared for immediate wake-up, prevention of hypotension, and bilateral radial artery monitoring.

The extreme tortuosity could complicate adequate introduction of the stent graft. Therefore, we opted for a transapical through-and-through guidewire and the Gore cTAG stent graft with active control for its flexibility and correctable apposition.[5,6] A transbrachial guidewire can impede precise proximal positioning at the outer curvature of the short landing zone. Additionally, the pseudocoarctation (14 mm) could result in a significant hemodynamic gradient with the stent graft in situ. This can be targeted by balloon dilatation using a noncompliant transcatheter aortic valve balloon (percutaneous transluminal angioplasty) after confirmation of proximal and distal sealing.

Operative procedure. At first, arterial access was obtained percutaneously (ultrasound guided) into the right common femoral artery using a preclosure device (ProGlide; Abbott Cardiovascular, Plymouth, MN). Simultaneously, a small anterolateral thoracotomy provided access to the left ventricular apex, which also enabled evacuation of an eventual hemothorax

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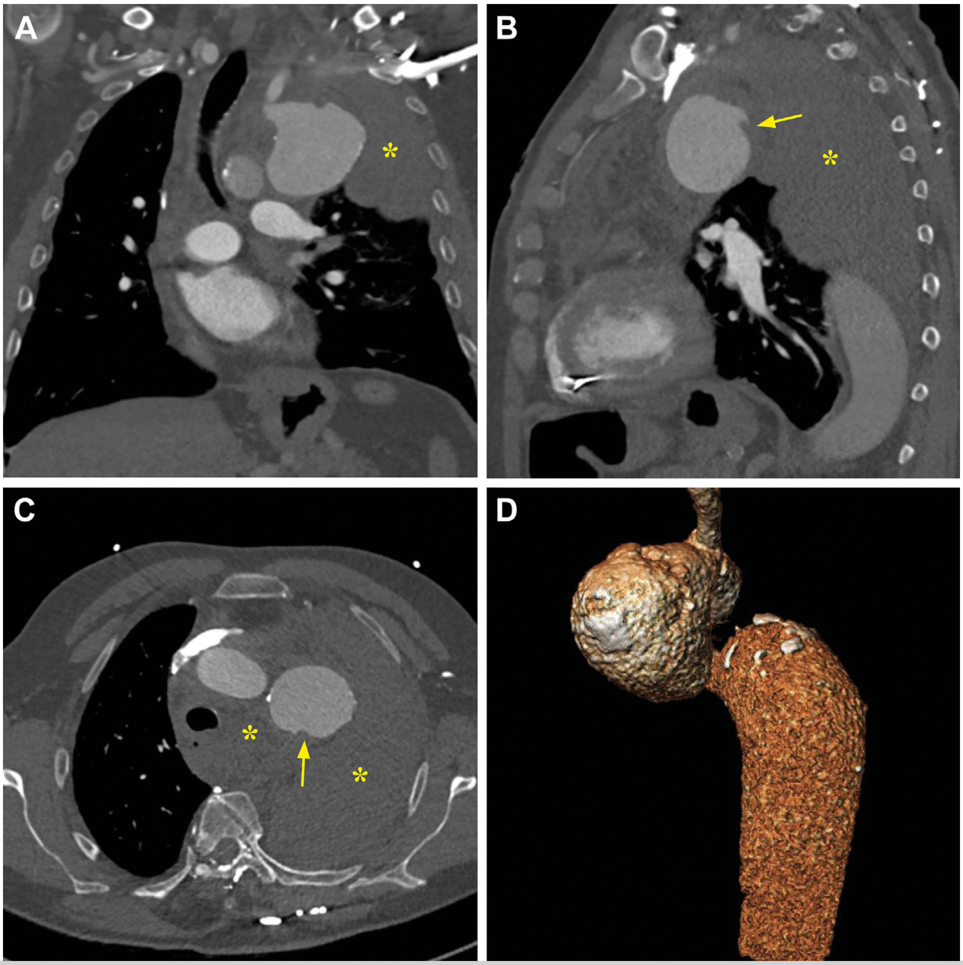

Fig 1. Preoperative computed tomography angiography (CTA) in coronal **(A)**, sagittal **(B)**, transversal **(C)**, and reconstruction **(D)** views. *Asterisk* indicates mediastinal and pleural hematoma. The posterior side of the aneurysm is irregular and suggestive of rupture (*arrow*). The diameters were as follows: proximal landing zone, 24 mm; aneurysm, 50 mm; coarctation, 14 mm; distal landing zone, 35 mm.

(which had not been detected). Additionally, an epicardial pacemaker wire was placed for temporary blood pressure control using rapid ventricular pacing (during post-ballooning). A 9F sheath was introduced at the apex in a double purse-string suture (3-0 Prolene on felt). Using a triple-loop snare (EN Snare; Merit Medical, South Jordan, UT), the Lunderquist wire was caught in the ascending aorta and externalized at the apex, creating the through-and-through guidewire (Fig 2).

By carefully applying the pull-and-push technique, we managed to guide the proximal stent graft (cTAG, 26 × 100 mm; W. L. Gore & Associates, Inc, Flagstaff, AZ) across the tortuosity and coarctation into the distal aortic arch (24 mm). The stent graft was positioned just distal to the left common carotid artery ostium, covering the LSA by intention. The left radial artery pressure immediately decreased to 70 mm Hg systolic (right-sided, 120 mm Hg). The following stent graft would ideally measure 31 mm in diameter, to allow for consecutive diameter overlap. However, the stent graft in hospital stock measured 150 mm in length, which would create an overlap zone precisely at the pseudocoarctation, risking an increase in gradient. Thus, we opted for a longer stent graft but with an increased diameter (cTAG 34 × 200 mm), ending distal to the coarctation. After deployment, the gradient across the pseudocoarctation remained 20 mm Hg systolic and 0 mm Hg mean. Percutaneous transluminal angioplasty was not indicated. The third stent graft (Gore cTAG, 37 × 150 mm) was deployed with adequate overlap, ending just above the intercostal arteries at the 11th thoracic vertebra. At the proximal and distal landing zones, we used 15% oversizing. We took advantage of the active control mechanism of the Gore cTAG device by angulating the proximal segment of the stent graft, aligning the inner curvature and preventing bird beak configuration. All overlaps in the stent grafts were subsequently postdilated with a highly compliant balloon (Reliant; Medtronic, Dublin, Ireland) under rapid ventricular pacing to prevent inadvertent migration (Fig 2).

Completion angiography showed adequate positioning of the stent grafts without endoleak. The left ventricular apex was hemostatic, and the small thoracotomy was closed in layers. The patient was extubated in the operating room and was

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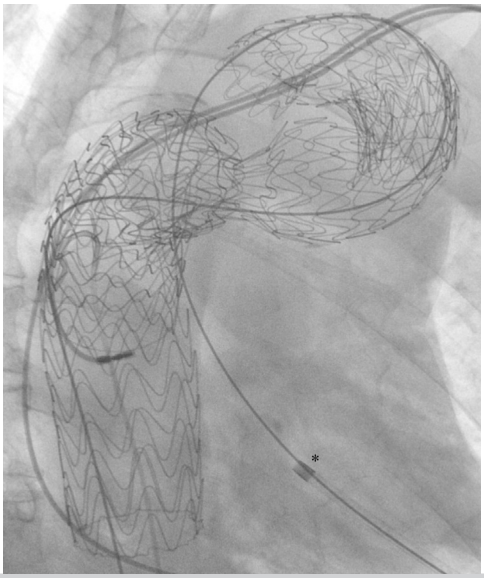

Fig 2. Radiograph at completion depicting deployed thoracic endovascular aortic repair (TEVAR; Gore cTAG, 26 × 100 mm, 34 × 200 mm, and 37 × 150 mm) in tortuous and coarctated aorta. *Asterisk* indicates 9F apical sheet and transapical through-and-through wire.

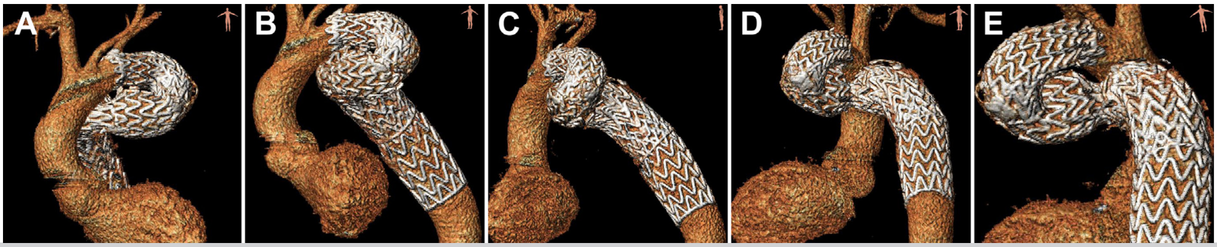

Fig 3. Three-dimensional reconstruction of postoperative computed tomography (CT) scan illustrating adequate thoracic endovascular aortic repair (TEVAR) positioning in tortuous aorta, including aortic coarctation. **A,** Anteroposterior view. **B,** Left anterior oblique view. **C,** Left lateral view. **D,** Left posterior oblique view. **E,** Extra view, focused on aortic coarctation.

transferred awake and hemodynamically stable to the intensive care unit with close monitoring of neurology and arterial blood pressure. Acetylsalicylic acid, 80 mg once daily, was started as per protocol. CTA at 1 week postoperatively confirmed adequate TEVAR positioning without an endoleak (Fig 3). The patient was discharged home at 14 days after surgery. At discharge, he had no signs of left arm malperfusion or central or spinal ischemia. An absence of endoleak and aneurysm sac regression was found on follow-up CTA at 6 months postoperatively. A cerebrovascular accident was reported after discharge.

DISCUSSION

The details of this case report reflect our considerations and the endovascular technique used to overcome extreme tortuosity and local narrowing in a ruptured TAA without a proper proximal landing zone, aiming to prevent invasive and high-risk open surgical repair.

The refinement of endovascular approaches during the past decades profiled TEVAR as an excellent solution for TAA repair. Confirmative of its less invasive approach, superior perioperative outcomes and significantly shorter intensive care and hospital stay have been reported compared with open surgery.[7-10] Open repair for our patient would have been accessed through left-sided thoracotomy. Because the distal arch was involved, deep hypothermic arrest would have been required. Although the outcomes of open surgery improved significantly over the years, the risks are still high with 6% 30-day mortality, 7% stroke, 5% paralysis, and 2% permanent dialysis for the elective patient. The risks increase with increasing age, the presence of renal insufficiency, an increased clamp time and/or circulatory arrest, and the absence of cerebrospinal fluid drainage. An emergency setting lacks the time required for workup and the use of a dedicated team. Therefore, the risks in emergency settings will be significantly higher, even for hemodynamically stable patients. The perioperative mortality for TAA ruptures was reported to be ≤11% to 57%.[11-15]

The use of endovascular approaches represent a good alternative. However, complex cases require an extensive plan to create proximal and distal landing zones, overcome tortuosity, create arterial access, and limit malperfusion risks. A 30-day mortality risk of 0% to 10% has been described.[9,16] Notwithstanding its success regarding the limited invasiveness, the vast disadvantage of TEVAR has been the limited insight regarding the long-term consequences. The limited available data have suggested that TEVAR might be related to an increased reintervention rate compared with open surgery. The need for reintervention has been thought to result from ongoing disease or inadequate preoperative planning and indication management.[8,16]

The details from this case have shown that an endovascular approach for this complex pathology can be performed safely and efficiently, underlining the role of preoperative planning in an aortic expertise center for highly complex cases.

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