Use of ascending aortic access for imaging and wire rail access for endograft delivery in complex aortic arch anatomy

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ABSTRACT

In cases of complex aortic arch anatomy, it can be difficult to obtain wire access into the ascending aorta for deployment of a thoracic endograft (thoracic endovascular aortic repair [TEVAR]) using a transfemoral approach. This can result from tortuosity or patulous aneurysmal areas, making platform stability difficult. We report the case of a young adult man with a large proximal left subclavian aneurysm that made zone 0 TEVAR placement very difficult with transfemoral access alone. Direct ascending aortic access through the open chest allowed for a stable through-and-through platform for endograft delivery, highlighting the efficacy of this seldom-needed technique during debranching TEVAR procedures. (J Vasc Surg Cases and Innovative Techniques 2021;7:6-9.)

Keywords: Arch debranching; Hybrid; Subclavian aneurysm; Through-and-through access; Zone 0 TEVAR

In patients with patulous and angulated arches, platform stability can be problematic for thoracic endovascular aortic repair (TEVAR) deployment. Direct access to the native ascending aorta has not been well described but has recently been applied for antegrade endograft delivery secondary to limited retrograde access.[1,2] In the present case, we treated a large proximal left subclavian origin aneurysm using total arch debranching and direct ascending aortic sheath access to provide aortography and secure through-and-through wire rail access with the right femoral artery. The institutional review board of the University of Virginia Health System approved the present report, and the patient provided written informed consent for the report of his case.

CASE REPORT

A 36-year-old man had been transferred to our hospital with complaints of left upper chest and arm pain, and syncopal episodes. Computed tomography angiography showed an 8.2-cm left subclavian artery origin aneurysm and mild aortic pseudocoarctation (Fig 1). He had no other pertinent medical history and had never smoked. Genetic and nonatherosclerotic arteriopathy evaluations had been performed at age 21 when the aneurysm was 3 cm with negative results; however, subsequently, he had been lost to follow-up. He had no previous or current suggestion of infection or trauma. Combined aortic arch debranching and TEVAR was planned. We were concerned that the patulous subclavian artery origin and 90° angulations in the distal and transverse arch might cause undue endograft mobility and stress. Therefore, a bridging TEVAR piece was planned with a longer zone 0 delivery piece traversing the first piece into the descending aorta to reduce this. Owing to this absence of lateral curvature, we believed that maximizing the proximal landing zone of the normal aorta into zone 0 with complete arch debranching was important to minimize potential migration and the development of endoleak. Via sternotomy with left supraclavicular extension, a left carotid to subclavian bypass was performed using 8-mm Dacron. After lowering the systolic blood pressure to <100 mm Hg, a side-biting clamp was placed on the anterolateral ascending aorta, and a 12-mm Dacron graft was anastomosed. A 7-mm Dacron graft was sewn to the left side of the 12-mm graft, tunneled under the innominate vein, and sewn to the transected left common carotid artery in an end-to-end fashion. Debranching was completed with an end-to-end anastomosis of the distal 12-mm graft to the innominate artery. The proximal ends of the innominate and left carotid were oversewn with doubly pledgeted sutures immediately after transection. The left femoral arterial line was exchanged for a 6F, 25-cm sheath after line arteriography had confirmed placement. Preclosure of the right femoral artery was accomplished, and an 8F, 25-cm sheath was placed into the aorta. Intravenous heparin was administered, and the activated clotting times were maintained at >250 seconds throughout arch manipulation and endograft deployment. We then proceeded with zone 0 TEVAR. However, the patulous subclavian origin and two tortuous arch angles made ascending aortic catheterization from the groin difficult

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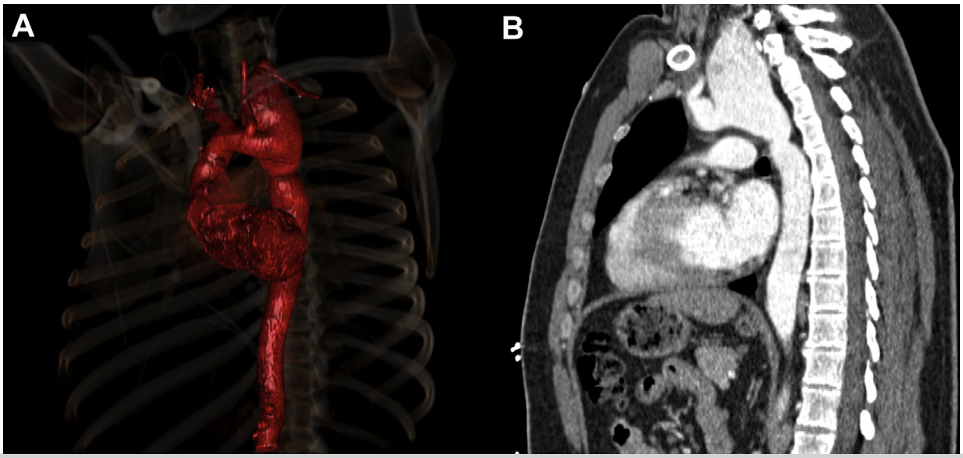

Fig 1. Three-dimensional computed tomography reconstruction **(A)** and standard computed tomography angiography **(B)** of the aorta and supra-aortic trunks demonstrating a patulous 8-cm left subclavian aneurysm causing lack of outer arch curvature, with distal arch and transverse arch severe angulation and distal pseudocoarctation. These features made traditional transfemoral catheterization and stiff wire placement in the ascending aorta difficult.

owing to the wire and catheter bowing into the left subclavian artery aneurysm. This led to wire loss, regardless of the catheter or sheath advanced. We were concerned that the angle required to access the ascending debranching graft on the lateral ascending aorta was in such a position that it would increase the risk of iatrogenic dissection or anastomotic damage. Therefore, we prepared two, two-stitch purse-string arterial cannulation sites on the more anterior and proximal ascending aorta. This also allowed for the most proximal zone 0 deployment possible. Systolic blood pressure was maintained at <100 mm Hg. A 5F, 11-cm sheath was inserted antegrade in the more proximal site for catheter-based aortography (Fig 2). With proper image intensifier positioning, the sternal retractor did not affect image quality. A 7F, 11-cm sheath was placed through the more cephalad and medial site for wire manipulation (Fig 2). Similar to the retrograde approach, stable stiff wire access into the descending aorta was not possible. Using an EN Snare (Merit Medical, South Jordan, Utah) positioned in the descending aorta from the ascending aorta 7F sheath, we drove a Glidewire (Terumo, Tokyo, Japan) from the right femoral sheath and pulled the wire through the ascending aortic sheath. Over this wire, a 150-cm CXI catheter (Cook Medical, Bloomington, Ind) was advanced from the right groin to come out the ascending sheath. We applied gentle pressure to the ascending sheaths when removing the catheters and wires to prevent dislodgment. With traction on each end of the CXI catheter, the glidewire was exchanged for a Lunderquist wire (Cook Medical), which was secured at the chest. This resulted in excellent stiff wire rail position for placement of our two arch endoprostheses from the femoral artery. The CXI catheter (Cook Medical) was removed from the right groin. A 30- × 30- × 150-mm Valiant Captiva (Medtronic, Santa Rosa, Calif) closed web piece was placed as the first graft across the tortuous arch and the subclavian aneurysm for support. A 31- × 31- × 174-mm Valiant Navion (Medtronic) free flow was deployed as the second piece from the ascending graft in zone 0 through the previous endograft into the descending aortic landing zone (Fig 3). As both devices were advanced, the 7F sheath was withdrawn to accommodate, leaving the sheath tip in for the first and allowing the device nosecone tip to advance slightly through the ascending aorta, controlled by the purse-string sutures, for the second, with replacement of the sheath as the delivery system was removed. The distal subclavian aneurysm was ligated just proximal to the vertebral artery after it had been depressurized. The sheaths and wires were removed. Groin closure bilaterally was successful. Ascending cannulation sites were hemostatic. The patient recovered from the procedure well without any major complications or endoleaks and was discharged on postoperative day 3. The immediate postoperative and 1-year computed tomography angiograms indicated good graft placement without issue (Fig 3).

DISCUSSION

The transfemoral approach to TEVAR is the preferred mode of access and delivery. However, in some circumstances, this will not be possible, and alternative and/or adjunctive access for either delivery or support will be needed.[3-9] The ascending aorta is an often overlooked but technically feasible access site for either direct endograft delivery or to achieve a more stable wire rail for retrograde endograft deployment.[2] In the present case, we recognized the potential difficulty for catheterization of the ascending aorta and prepared for the use of the ascending aorta because this was disease free and readily accessible, given concurrent debranching. We identified that use of the debranching graft for direct access or via brachial access was not wise, given its anterolateral position on the aorta. We needed a less-angulated and more proximal platform for deployment. We also discussed direct endograft delivery via

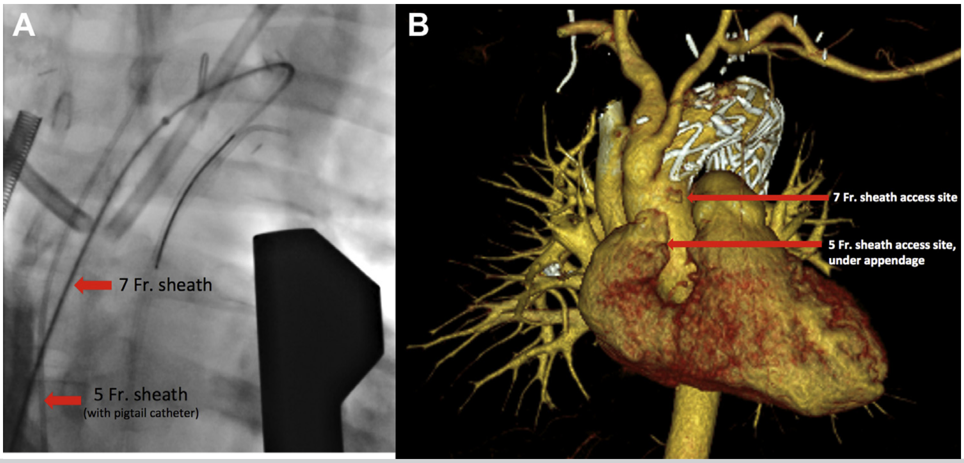

Fig 2. A, Intraoperative fluoroscopic image demonstrating antegrade sheath placements in the ascending aorta. The more proximal 5F sheath was placed for flush catheter imaging and the 7F sheath for wire access. **B,** One-year postoperative computed tomography angiogram three-dimensional reconstruction showing pledgeted repair of the 7F cannulation site; the 5F site lies underneath the right atrial appendage. The thoracic endovascular aortic repair pieces were well seated and expanded, with good arch flow and supra-aortic trunk flow. No endoleak or flow was present in the left subclavian artery aneurysm, which had regressed to 2.5 cm.

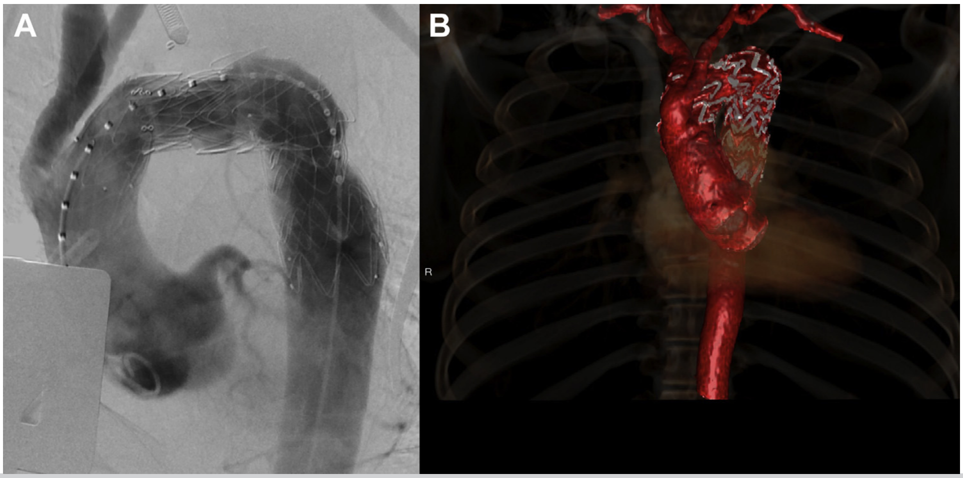

Fig 3. Completion aortography after removal of the ascending aortic sheaths and securing of cannulation sutures via a transfemoral pigtail catheter **(A)** and immediate postoperative computed tomography angiography reconstruction **(B)** demonstrating successful zone 0 thoracic endovascular aortic repair placement without evidence of endoleak and exclusion of left subclavian aneurysm with good arch debranching and supra-aortic trunk flow.

ascending access. However, no anatomic limitations were present in iliofemoral access, and delivery from below was more ergonomically sound, allowing for use of planned endografts. Furthermore, we did not require more complex closure with a larger sheath size in the ascending aorta or left ventricular apex. Future arch branch devices with multiple access sites might make this type of access and procedural strategy secondary. However, these will likely also have anatomic limitations.[10] Regardless, the technique described may be useful in scenarios in which retrograde TEVAR delivery is feasible but hindered by difficult aortic arch tortuosity and aneurysm anatomy.

CONCLUSIONS

TEVAR delivery and deployment in the proximal arch might require alternative access techniques. A solution to difficult catheterization of the proximal arch is the use of direct ascending aortic access to achieve a stable through-through wire rail platform in cases of combined debranching and zone 0 TEVAR placement.

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