

# Single-stage total endovascular therapy for an aberrant right subclavian aneurysm

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## ABSTRACT

A 34-year-old woman who demonstrated an aberrant right subclavian artery aneurysm was referred to our hospital. Single-stage total endovascular therapy with preservation of the right vertebral artery using a surgeon-modified fenestrated stent graft was performed. Contrast-enhanced computed tomography on postoperative day 4 revealed the patency of the right vertebral artery with no evidence of endoleaks. The patient was discharged on postoperative day 6. Three years later, the patient had no adverse events. When an aberrant right subclavian artery aneurysm is anatomically suitable, single-stage total endovascular therapy for such an aneurysm is considered to be a feasible and appropriate minimally invasive treatment. (*J Vasc Surg Cases and Innovative Techniques* 2020;6:450-3.)

**Keywords:** Aberrant right subclavian artery; Aneurysm; Stent graft; Endovascular therapy; Thoracic endovascular aneurysm repair

An aberrant subclavian artery (SA) is one of the most common congenital vascular anomalies of the aortic arch (AoAR). The incidence of an aberrant right SA (ARSA) is 0.4% to 2.3%.<sup>1</sup> Until roughly 20 years ago, open repair with thoracotomy was the only surgical treatment available for ARSA aneurysm, and it was a high-risk surgery.<sup>2,3</sup> Since 1998, however, various endovascular or hybrid approaches for treating patients with ARSA have been reported.<sup>4-9</sup> We herein report single-stage total endovascular therapy for an ARSA aneurysm with preservation of the right vertebral artery (RVA) using a surgeon-modified fenestrated stent graft.

The patient gave her informed consent for the publication of the details and images related to this report.

## CASE REPORT

A 34-year-old woman was referred to our hospital after a chest radiograph abnormality was noted during a medical checkup. The patient had no complaints or remarkable medical history. Contrast-enhanced computed tomography (CT) scan showed a left-sided AoAR with an ARSA aneurysm. The size of the aneurysm was 33 mm with a saccular shape. The first branch of the AoAR was the common trunk, composed of the right and left common carotid arteries, and the second was the left SA. The

right SA was the last branch of the AoAR directly originating from the AoAR without Kommerell's diverticulum (*Fig 1*). Although the patient had no complaints, elective surgery was planned based on the risk of rupture.

The diameter of the proximal neck ranged from 11 to 14 mm, the length of the proximal neck was 20 mm, the length of the aneurysm was 50 mm, the distance from aneurysm to RVA was only 5 mm, and the diameter of the right axillary artery (RAXA) was 6



**Fig 1.** Preoperative three-dimensional computed tomography (CT) angiography showing a left-sided aortic arch with the aberrant right subclavian artery (SA), which was the last branch of the aortic arch directly originating from the aortic arch, and the aberrant right SA (ARSA) aneurysm with a saccular shape.

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Author conflict of interest: none.

Presented at the Thirty-third Annual Meeting of the European Society for Vascular Surgery, Hamburg, Germany, September 27, 2019.

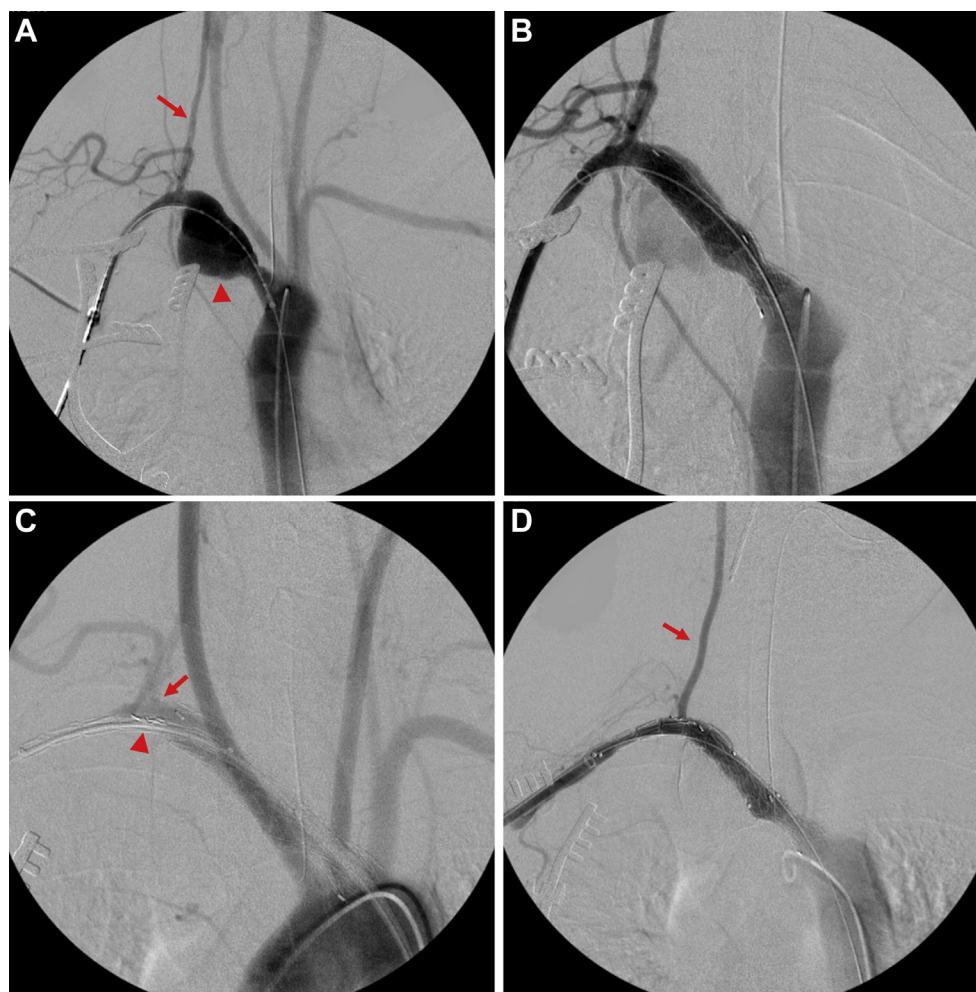
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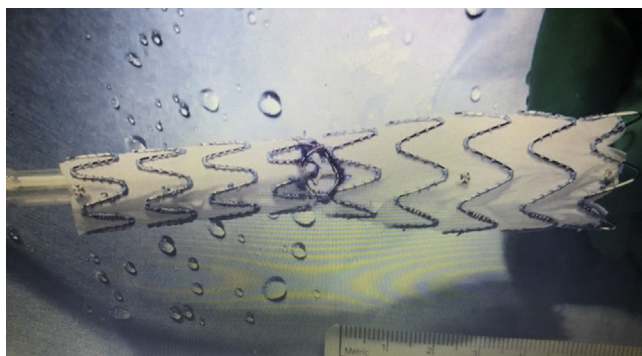
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<https://doi.org/10.1016/j.jvscit.2020.07.005>



**Fig 2.** Operative angiography showing the aberrant right subclavian artery (SA) aneurysm (arrowhead) and right vertebral artery (RVA) (arrow) (A), the first stent graft, which had been deployed (B), the marker of the fenestration (arrowhead) aligned at the origin of the RVA (arrow) (C) and the preservation of the RVA (arrow) with no evidence of endoleaks (D).



**Fig 3.** A picture showing the surgeon-modified fenestrated stent graft with the coil sutured onto the graft at the margin of the fenestration as a radiopaque marker.

to 7 mm. The diameter of the bilateral vertebral arteries was almost the same, according to the findings of magnetic resonance angiography. Single-stage total endovascular therapy with preservation of

the RVA using a surgeon-modified fenestrated stent graft was therefore planned based on an anatomic assessment.

The operation was performed under general anesthesia and fluoroscopic guidance in an operating room. The patient was placed in a supine position, the RxA was exposed through an infraclavicular approach, a 6F sheath was percutaneously inserted via the right femoral artery, and a 9F sheath was directly inserted via the RxA. A pigtail catheter was passed into the AoAR from the 6F sheath of the right femoral artery. A Lunderquist stiff guidewire (Cook Medical Inc, Bloomington, Ind) was passed into the descending aorta from the 9F sheath of the RxA through the ARSA aneurysm, and the 9F sheath was then replaced with a 12F Dry-Seal Sheath (W. L. Gore & Associates, Inc, Flagstaff, Ariz). An EXCLUDER iliac extender 16-12-70 mm (W. L. Gore & Associates, Inc) was inserted into the 12F Dry-Seal Sheath and deployed from the proximal landing zone to the inside of the ARSA aneurysm (Fig 2, A and B). An ENDURANT II contralateral limb 16-10-93 mm (Medtronic World Medical, Sunrise, Fla) was then deployed on the clean table. A fenestration 5 mm in size was made at the graft between the fifth



**Fig 4.** Three-dimensional computed tomography (CT) angiography on postoperative day 4 showing the patency of the right vertebral artery (RVA) (arrow) and the right axillary artery (RAXA) with no evidence of endoleaks.

and sixth stents, and a Tornado (Cook Medical Inc) coil was sutured to the graft at the margin of the fenestration with 5-0 polypropylene sutures using running sutures, as a radiopaque marker (Fig 3). The surgeon-modified stent graft was then resheathed in the original sheath of the ENDURANT II. The ENDURANT II was directly inserted via the RAXA and deployed at the position at which the radiopaque marker was positioned, at the orifice of the RVA (Fig 2, C).

Completion angiography revealed the patency of the stent graft, RVA, and RAXA, with no major endoleaks (Fig 2, D). The RAXA was repaired by purse-string sutures. The operative time was 144 minutes, 150 mL of contrast was used and, the fluoroscopy time was 12 minutes 9 seconds. The postoperative course was uneventful. A contrast-enhanced CT scan on postoperative day 4 showed the patency of the stent graft, RVA, and RAXA with no evidence of endoleaks (Fig 4). The patient was discharged on postoperative day 6. One year later, a follow-up CT scan showed that the ARSA aneurysm had decreased in maximum diameter from 33 to 27 mm (Fig 5, A and B). Three years later, the patient had no adverse events.

## DISCUSSION

Although we initially considered thoracic endovascular aortic repair with bilateral carotid-subclavian bypass, we finally selected minimally invasive total endovascular therapy for three reasons, namely, the patient's social

background, the morphologic aspects of the ARSA, and the backup plans we had firmly in place. First, the patient needed to be discharged and resume her daily life as soon as possible because she was the mother of three young children. Second, we considered that it was undesirable to ligate the ARSA proximal to the RVA because the aneurysmal change of the ARSA arose just proximal to the RVA. As a result, neither ARSA ligation nor transposition were selected. Furthermore, the proximal neck was too short to successfully occlude with a plug. Finally, backup plans were prepared for RVA occlusion and any remaining endoleaks. If the patient were to demonstrate symptoms after the RVA occlusion, we would then perform RVA transposition. If no symptoms or endoleaks occurred, then we would observe the patient without any additional procedures. If a type III endoleak developed from the fenestration, then an additional small stent graft would be inserted to close it and, if needed, RVA transposition would also be performed. If a type Ia endoleak occurred, then thoracic endovascular aortic repair with bilateral carotid-subclavian bypasses would be performed. Because the diameter of the bilateral vertebral arteries without branches were almost the same and intracranial arterial communication appeared to pose no problem based on magnetic resonance angiography, we thought that the chance that RVA transposition would be needed was low, although a balloon occluding test of the vertebral artery was not performed.

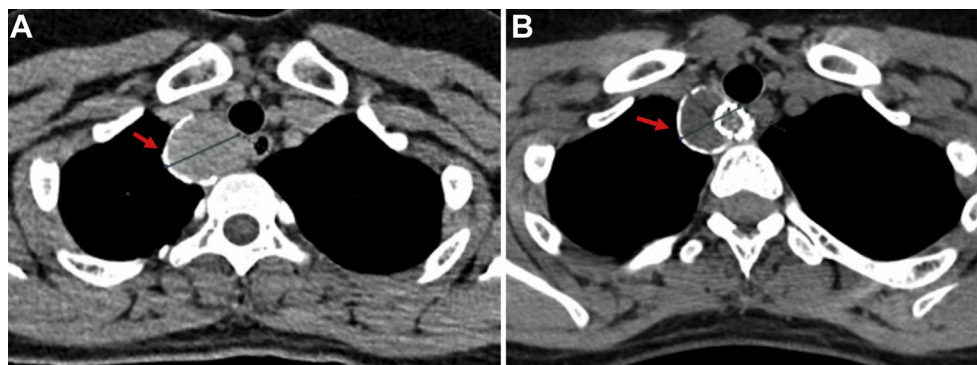
In addition to the described procedures, although we initially used a 9F sheath to perform intravascular ultrasound examination; however, intravascular ultrasound examination was not required. We had to use the two different kinds of stent grafts for two reasons, the first reason being the treatment range and the other whether or not the stent graft could be successfully fenestrated and resheathed. Regarding the method of aligning the fenestration, the radiopaque marker of the fenestration was accurately aligned at the marker of the orifice of the RVA, which was directly marked on the monitor while rotating the delivery system. Furthermore, placing a guide wire from the groin up into the RVA is a useful option to help in the alignment of the fenestration.

Open surgery for an ARSA aneurysm is associated with mortality rates ranging from 25% to 33%.<sup>2,3</sup> In contrast, endovascular therapy for ARSA aneurysm is associated with mortality rates of just 6.5%.<sup>1</sup> However, both the number of patients and follow-up data regarding endovascular repair for ARSA remain insufficient.

## CONCLUSIONS

When an ARSA aneurysm is anatomically suitable, single-stage total endovascular therapy for such an





**Fig 5.** Preoperative computed tomography (CT) scan showing the aberrant right subclavian artery (SA) aneurysm (arrow) measuring 33 mm in diameter **(A)** and postoperative CT one year later showing the aneurysm (arrow) to have decreased in diameter (27 mm) **(B)**.

aneurysm with preservation of the RVA using a surgeon-modified fenestrated stent graft is considered to be feasible an appropriate treatment consisting of minimally invasive therapy. Careful follow-up is needed, because the long-term outcome is unknown.

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Submitted Apr 11, 2020; accepted Jul 2, 2020.