Endovascular treatment with an iliac branch endoprosthesis for a right subclavian artery aneurysm

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ABSTRACT

Subclavian artery aneurysms are rare peripheral artery aneurysms, and open surgical repair is the reference standard treatment. We have reported the case a patient with a right subclavian artery aneurysm who was not indicated for open surgical repair because of comorbidities. Thus, endovascular treatment using the Gore Excluder Iliac Branch Endoprosthesis (WL Gore and Associates, Flagstaff, Ariz) was performed, leading to complete aneurysmal exclusion without perioperative complications. Although anatomic limitations exist, this technique could be alternative treatment option for right subclavian artery aneurysms. (J Vasc Surg Cases and Innovative Techniques 2022;8:35-8.)

Keywords: Branched stent-graft; Endovascular treatment; Stent graft; Subclavian artery aneurysm; TEVAR

Subclavian artery aneurysms (SCAAs) are rare peripheral artery aneurysms estimated to account for 0.13% to 1% of all aneurysms.[1-3] They have the potential risk of distal embolization, thrombosis, compression of contiguous structures, and rupture.[1,4]

Conventional treatment of SCAAs requires median sternotomy or thoracotomy, because they are mostly located in the proximal segment of the subclavian artery. With the development of endovascular treatment, hybrid endovascular treatment combined with open surgery has been reported.[5-7]

In the present case report, we have described endovascular treatment of a right SCAA (RSCAA) using the Gore Excluder Iliac Branch Endoprosthesis (IBE; WL Gore and Associates, Flagstaff, Ariz). The institutional review board at The Jikei University School of Medicine approved the report of the case (approval no. 32-089[10164]), and the patient provided written informed consent.

CASE REPORT

A 77-year-old man was referred by the cardiac surgery department for treatment of an RSCAA measuring 32 mm in diameter. He had ischemic heart disease, including an untreated coronary lesion, and interstitial pneumonia. In addition to the RSCAA, computed tomography (CT) angiography revealed a thoracic aortic aneurysm (TAA) measuring 45 mm in diameter and an abdominal aortic aneurysm (AAA) measuring 35 mm in diameter. The RSCAA had a saccular form projecting posterior from its origin for a length of 20 mm (Fig 1). The diameters of the brachiocephalic artery (BCA), right common carotid artery (RCCA), and RSCA were 16 mm, 9 mm, and 8 mm, respectively. The length of the BCA was 60 mm. The right vertebral artery (VA) arose 10 mm distal to the RSCAA with stenosis at its origin. The left VA was dominant, and intracranial communication of the bilateral VAs was confirmed on CT angiography.

Based on the discussion with the cardiac surgery team, the decision was made to treat the RSCAA first using the Gore IBE (WL Gore and Associates), and the patient provided consent for this off-label use as treatment.

Operative procedure. The operation was performed with the patient under general anesthesia and intraoperative noninvasive monitoring of regional cerebral oxygen saturation using near-infrared spectroscopy (INVOS 5100C; Somanetics, Minneapolis, Minn). A 5F short sheath (Terumo Medical Co, Tokyo, Japan) was placed percutaneously at the right femoral artery, and the Pigtail Angiographic Catheter (Cook Medical, Bloomington, Ind) was advanced and positioned proximal to the BCA. The SCAA and TAA were visualized on aortography (Fig 2). The RCCA was exposed using a small incision, as reported previously.[8] The distal RSCA was exposed using an infraclavicular incision. After systemic heparinization, selective right VA angiography was performed using the Impress Diagnostic Peripheral Catheter (Merit Medical, South Jordan, Utah), which revealed communication of the bilateral VAs and a 75% stenotic lesion at the origin of the right VA. A 16F Dryseal sheath and a 12F Dryseal sheath (WL Gore and Associates) were inserted from the RCCA and RSCA, respectively. The pull-through wire system, which was through both Dryseal sheaths, was established using the Radifocus Guidewire (Terumo Medical Co) and the Ensnare system (Merit Medical). The Gore IBE component (catalog no. CEB231010) was introduced from the 16F Dryseal sheath and deployed at the intended position. After deployment of the IBE component, the Gore Excluder Contralateral Leg (catalog no.

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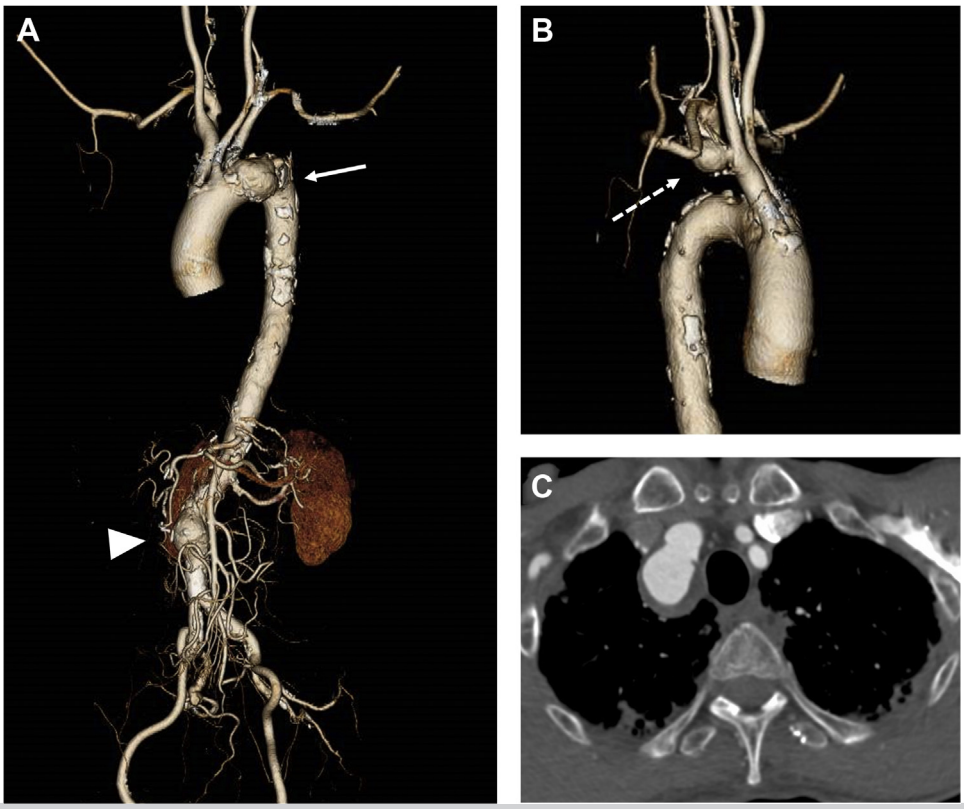

Fig 1. Preoperative computed tomography (CT) angiography. **A,** Reconstructed three-dimensional image of left oblique view. **B,** Reconstructed three-dimensional image of right oblique view. **C,** Axial image. These images show the thoracic aortic aneurysm (TAA; *white arrow*), abdominal aortic aneurysm (AAA; *white arrowhead*), and saccular right subclavian artery aneurysm (RSCAA), which was projecting posteriorly (*white dotted arrow*).

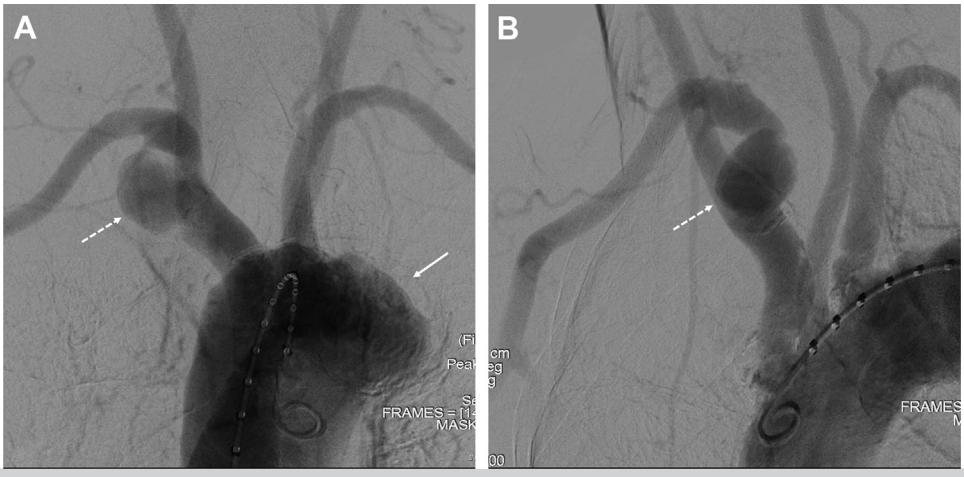

Fig 2. Preoperative angiography. **A,** Right oblique view. **B,** Left oblique view. Both angiographic images show the right subclavian artery aneurysm (RSCAA; *white dotted arrow*) and thoracic aortic aneurysm (TAA; *white arrow*).

PLC161000) was introduced from the 12F Dryseal sheath and deployed. To secure a sufficient distal landing length, the right VA was sacrificed. Simultaneous balloon dilatation was performed using the MAXI LD PTA Dilatation Catheter (15-40 mm; Cordis Corp, Fremont, Calif) and the Mustang PTA balloon Dilatation Catheter (10-20 mm; Boston Scientific, Natick, Mass). Final angiography confirmed that the RSCAA was completely excluded without endoleaks (Fig 3).

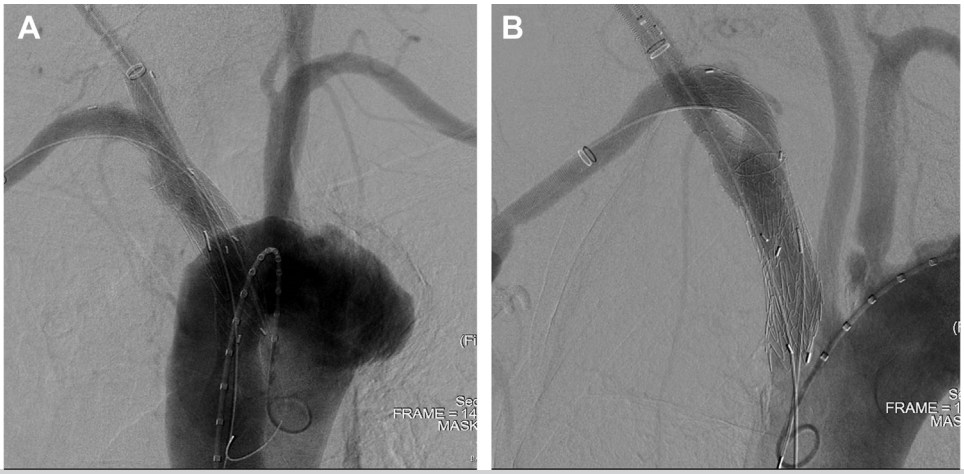

Fig 3. Final angiography. **A,** Right oblique view. **B,** Left oblique view. Both angiography images show the excluded right subclavian artery aneurysm (RSCAA).

Postoperative course. The patient was discharged home on postoperative day 5 without complications. On outpatient review at 3 months, the patient was well. No differences in right and left blood pressure were observed. Postoperative CT angiography demonstrated the thrombosed SCAA, which was 28 mm in diameter, with no evidence of endoleaks or stent-graft (SG)–related complications (Fig 4). The remaining TAA and AAA are still under surveillance without intervention.

DISCUSSION

Total endovascular treatment using the Gore IBE was performed for an intrathoracic RSCAA in a patient who was not indicated for open surgery. Because SCAAs are relatively rare, their natural history is unclear, and no consensus has been reached regarding the optimal timing of operative intervention. Our case, a saccular and intrathoracic RSCAA, was considered eligible for intervention to prevent fatal rupture into the thoracic cavity, embolization to the upper limb, and posterior circulation stroke. Similar to a recent report of frequent multiple aneurysms in aortic arch branch vessels,[9] the TAA and AAA were identified simultaneously in our patient. Surgical intervention was only indicated for the RSCAA because the size of both the TAA and AAA was inappropriate for treatment.

The selected open surgical procedure for a SCAA depends on its location. Extrathoracic SCAAs can be treated via the supraclavicular approach, and intrathoracic SCAAs require sternotomy or thoracotomy and a circulation device, as necessary.[2,10,11] In the case of an RSCAA accompanied by an TAA indicated for treatment, both can be treated simultaneously by aortic arch replacement. However, if the TAA does not meet the treatment indications, sternotomy and thoracotomy for RSCAA could be highly invasive and make a secondary procedure for the TAA difficult.

Endovascular treatment of SCAAs was first reported in 1996.[12] In that report, the left SCAA was treated using a straight-type SG. A similar technique was reported for a RSCAA,[13] and a sufficient proximal landing zone was secured in both cases. Recently, the hybrid technique (ie, endovascular treatment combined with the bypass procedure) was reported for SCAAs with an insufficient proximal landing zone.[6] Regarding RSCAAs, the chimney technique can be applied for the BCA and RSCA. Comparing the hybrid technique and chimney technique, the former has potential concerns regarding graft patency and graft infection, and the latter has a disadvantage of developing a gutter between the SG and the native artery wall. Treatment using the IBE overcomes these disadvantages; however, this treatment violates the instructions for use, and the available cases are limited owing to the anatomic criteria. The instructions for use specify a diameter of the distal landing artery of ≥6.5 mm. The average diameter of the RCCA and RSCA were reported to be 0.7 cm and 0.9 cm, respectively[14]; therefore, the distal artery diameter meets the anatomic criteria. One issue is the length of the BCA because the length from the tip of the IBE component to the end of the contralateral gate is 5.5 cm. If the length of the BCA is <5.5 cm, the IBE component will project into the aorta. If the diameter of the BCA is insufficient, SG infolding is of concern. Because the diameter and length of the BCA were 1.6 cm and 6.0 cm, respectively, the IBE was applicable in our case. For RSCAAs, the through-and-through wire technique from the LCCA to the RSCA is not essential to assemble the IBE. However, using this technique might aid in adjusting the direction of rotation of the SG and deploying its contralateral gate at the appropriate position, preventing the IBE component from falling into the aorta. The patency on the contralateral side of the IBE at 3 years was reported to be 95.1% compared with patency of 100% on the

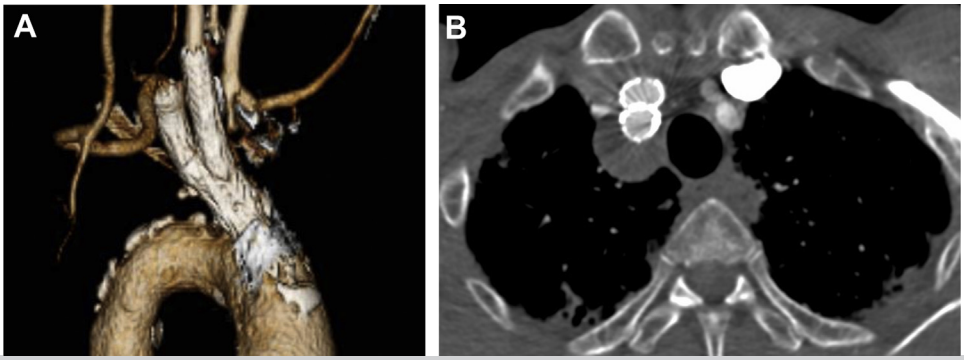

Fig 4. Computed tomography (CT) at 3 months postoperatively. **A,** Reconstructed three-dimensional image of right oblique view. **B,** Axial image. These images show the excluded right subclavian artery aneurysm (RSCAA) without stent-graft (SG) fracture.

ipsilateral side.[15] Considering that occlusion of the contralateral limb causes stroke, the IBE component should be advanced from the LCCA with care.

In the case of intrathoracic RSCAAs, preoperative evaluation of the intracranial communication of the bilateral VAs is essential before coverage of the right VA. Moreover, from the viewpoint of preventing SG fracture, the absence of thoracic outlet syndrome should be evaluated preoperatively using impingement study by pulse volume recordings or ultrasonography, with provocative maneuvers. Although several points require caution and the available cases are limited, endovascular treatment using an IBE could be an effective and alternative treatment option for RSCAAs in patients not indicated for open surgery.

CONCLUSIONS

We have concluded that endovascular treatment using a branched device could be an alternative treatment option for RSCAAs, especially for patients not indicated for open surgery because of their comorbidities.

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