Fenestrated endovascular repair of aortic arch aneurysm in patients with bovine arch using the Najuta stent graft

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ABSTRACT

We describe the case of a 74-year-old man with a thoracic aortic aneurysm with a bovine arch who underwent fenestrated endovascular repair of aortic arch aneurysm using the Najuta stent graft (Kawasumi Laboratories, Inc, Tokyo, Japan). He has had a previous endovascular aneurysm repair and femoropopliteal bypass for abdominal aortic aneurysm combined with peripheral arterial disease. The Najuta stent graft was inserted and deployed at zone 0 with delicate positional adjustment of the fenestration of the stent graft to the brachiocephalic trunk. There was no endoleak or complication. His postoperative course was uneventful. At 7-month follow-up, complete exclusion of the aneurysm was noted. The Najuta stent graft repair of aortic arch aneurysms is a safe and effective treatment option for patients with a bovine arch. (J Vasc Surg Cases and Innovative Techniques 2018;4:148-51.)

Bovine arch is the most common variant of the aortic arch and occurs when the brachiocephalic (innominate) artery shares a common origin with the left common carotid artery. During thoracic endovascular aortic repair (TEVAR) in patients with a bovine arch, an endovascular strategy is often necessary for the preservation of blood circulation in the brachiocephalic trunk and exclusion of the sac. We report the fenestrated endovascular repair of an aortic arch aneurysm using the Najuta stent graft (Kawasumi Laboratories, Inc, Tokyo, Japan) without a debranching bypass in the setting of bovine arch anatomy. Consent of the patient was obtained to publish this report.

CASE REPORT

A 74-year-old man presented with a rapidly expanding aortic arch aneurysm after treatment of an abdominal aortic aneurysm with a stent graft. Computed tomography revealed a bovine arch (left common carotid artery originating from the brachiocephalic trunk), an aortic arch aneurysm, and an occlusion of the proximal left subclavian artery (LSA; Fig 1). He has had a previous endovascular aneurysm repair and femoropopliteal bypass for abdominal aortic aneurysm combined with peripheral arterial disease. He underwent fenestrated TEVAR using the Najuta stent graft; the aneurysm was 46 mm in diameter and had grown by 7 mm in 1 year.

The Najuta fenestrated stent graft, which is a customized device composed of a self-expandable stainless steel Z-stent and an expanded polytetrafluoroethylene (ePTFE) graft, was approved for use in Japan in January 2013.[1,2] A three-dimensional (3D) manufactured patient-specific model of the aortic arch was used to produce a physical plaster model in a 3D printer (Eden350V; Stratasys Ltd, Eden Prairie, Minn). A customized full-scale stent graft model was deployed to the plaster model before TEVAR (Fig 2). The use of an anatomic plaster model produced by the 3D printer is effective for obtaining a geometric analysis of the fenestrations.[3] The proximal (and distal) neck diameter is 20 to 38 mm according to the instructions for use. The stent graft diameter of the Najuta is 24 to 42 mm. It has been ensured that fixation of the Najuta will be successful without any endoleaks if there is at least 20 mm of healthy aorta from the left carotid or subclavian artery to the margin of the aneurysm.

The patient's abdominal aortic aneurysm had been treated with the Excluder endovascular graft (W. L. Gore & Associates, Flagstaff, Ariz); he had also undergone right external iliac stent placement and left femoropopliteal bypass with an ePTFE graft. Left external iliac access and right brachial access were achieved by a cutdown. A 6F twin sheath (double-lumen introducer sheath) was introduced from the right brachial artery, and a 4F pigtail catheter was advanced over a guidewire to the ascending aorta.

The CTAG stent graft (W. L. Gore & Associates) was initially delivered into the aortic arch over a Lunderquist wire (Cook Medical, Bloomington, Ind). Angiography was used to deploy the uncovered portion of the graft across the brachiocephalic trunk and the covered portion across the LSA.

The guidewire was exchanged for a 0.032-inch Radifocus wire (Terumo, Tokyo, Japan), which was then pulled through the right brachial artery to the femoral artery. The Najuta fenestrated stent graft was delivered with a 23F J-shaped sheath maintained

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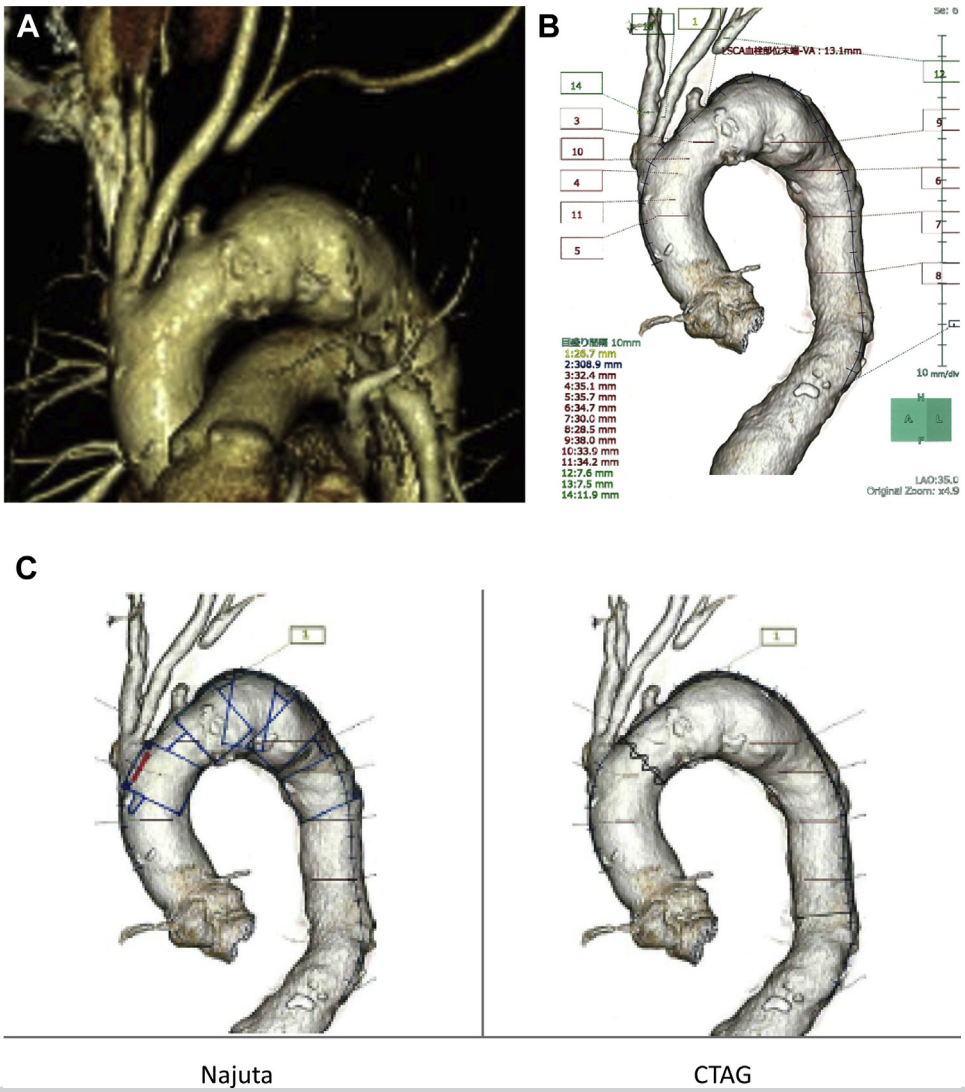

Fig 1. A, Preoperative computed tomography revealed a bovine arch, an aortic arch aneurysm, and an occlusion of the proximal left subclavian artery (LSA). **B,** Preoperative three-dimensional (3D) finding. **C,** Device implantation plan.

under continuous strain by traction at both wire ends (body floss technique).[3,4] Subsequently, it was delivered and deployed at the zone 0 proximal site with delicate positional adjustment of the fenestration of the Najuta stent graft to the brachiocephalic trunk. After endoprosthesis implantation, angiography revealed a patent brachiocephalic trunk and exclusion of the aneurysm (Fig 3, *A*).

His postoperative course was uneventful. Postoperative computed tomography revealed no endoleak. At the 7-month follow-up, complete exclusion of the aneurysm was noted (Fig 3, *B* and *C*).

DISCUSSION

The bovine arch is the most common variant of the aortic arch and has a common origin for the innominate and left common carotid arteries.[5] Estimates of bovine arch prevalence have been 8.7% to 27.4%.[6,7] In addition, a previous report demonstrated a significant association between presence of congenital bovine arch variant and development of thoracic aortic disease.[8]

Currently, the best approach to the aortic arch remains unsupported by robust evidence.[9] The feasibility of arch vessel debranching followed by TEVAR as a less invasive alternative approach for the treatment of arch diseases in high-risk patients has been supported by several reports and recent systematic reviews.[9-12] De Rango et al[9] revealed that arch endovascular repair can be applied with 5.8%, 3.8%, and 2.9% risk of mortality, stroke, and spinal cord ischemia, respectively. Conversely, native ascending aorta zone 0 stent graft placement was the only univariate predictor of 30-day mortality in a series of hybrid arch repairs.[13] In performing TEVAR of aortic arch aneurysm with a bovine arch, stent graft deployment at zone 0 is essential.

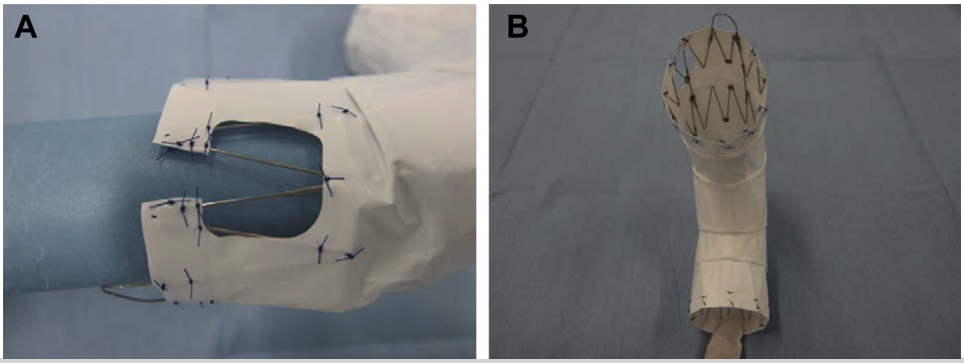

Fig 2. A, A fenestration of the Najuta stent graft. **B,** According to the position of the origin of the brachiocephalic trunk, the Najuta stent graft has a precut fenestration in the upper posterior wall of the outer curvature.

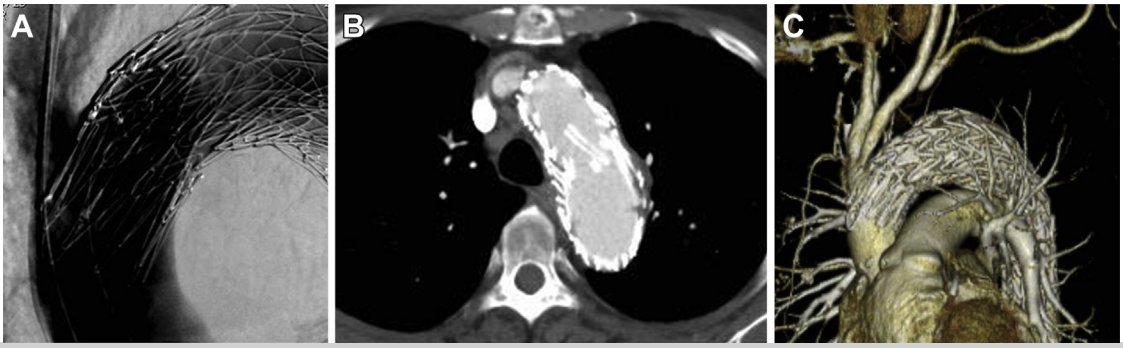

Fig 3. A, Aortography performed after fenestrated stent grafting. **B,** Follow-up computed tomography performed at 7 months showed complete thrombosis of the sac. **C,** Three-dimensional (3D) computed tomography reconstruction image 7 months after thoracic endovascular aortic repair (TEVAR).

Hybrid endovascular repair may be an alternative treatment for aortic arch aneurysm. Some custom-made arch-branch thoracic devices have currently been developed but are not yet commercially available.[14-16] If TEVAR is performed using a branched stent graft, the presence of a bovine arch makes cannulation of the neck branches difficult and sometimes requires debranching bypass surgery.[15] In addition, performing TEVAR with the chimney graft technique always results in the formation of a double chimney, which usually causes a gutter endoleak owing to the anatomic features of a bovine arch.[17,18]

TEVAR using the Najuta stent grafts can achieve a long proximal sealing length because of fenestration and enables accurate deployment without neck vessel reconstruction in patients with a bovine arch. This may shorten the operation time and reduce postoperative neurologic complications. Furthermore, TEVAR performed with a fenestrated stent graft deployed from zone 0 may also reduce the risk of late type IA endoleak and migration.[4,19]

With the exception of certain cases, including coronary circulation supplied from the LSA and poor vertebral-basilar circulation, we usually cover and occlude the LSA with the stent graft, without revascularization.[19] According to the instructions for use of the Najuta stent graft, if the proximal neck length between the LSA and aneurysm is >20 mm, the LSA could also be fenestrated to maintain antegrade blood flow. In this case, the origin of the LSA was occluded from the beginning, and there was no need to fenestrate the LSA or to perform a debranching bypass.

Because the stent is located inside an ePTFE graft, the Najuta stent graft has a relatively weak radial force. Therefore, in patients with fusiform aneurysms such as in this case, we placed the CTAG stent graft as an anchor at the distal site because of its conformability and trackability.

Fenestrated TEVAR using the Najuta can be simpler and safer than the other alternative endovascular treatments for aortic arch aneurysms. The features of the Najuta fenestrated stent graft are especially applicable to bovine arch cases.

CONCLUSIONS

The Najuta fenestrated stent graft repair can be successfully performed in patients with a bovine aortic arch.

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