Long-term durability of aortic arch in situ stent graft fenestration requiring lifelong surveillance

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We report successful endovascular repair of a 61-year-old man treated for a 7.1-cm excentric aortic arch aneurysm by in situ stent graft fenestration for the brachiocephalic trunk and the left common carotid artery. Cerebral perfusion during the intervention was maintained by pump-driven extracorporal bypass to the right common carotid artery and to the left axillary artery provided with a left carotid-subclavian bypass. After 5 years of follow-up, the aortic arch in situ revascularization is still patent, the aneurysm excluded, and no endoleak detectable, although endovascular reintervention with distal aortic stent graft extension due to dilatation of the descending aorta was required. (J Vasc Surg 2016;■:1-4.)

Aneurysms of the aortic arch can be treated by open surgery with extracorporal circulation, hybrid procedures with ascending aortic bypass, supra-aortic debranching, with endovascular aortic arch exclusion, or by using custom-made branched or fenestrated endografts.[1-3] A multicenter series of patients with aortic arch aneurysms treated by endovascular repair using inner branched endografts was recently reported with promising results.[4]

In situ fenestration of aortic stent grafts with antegrade perfusion of the brachiocephalic trunk and the left common carotid artery (CCA) might be another treatment option for exclusion of aortic arch pathologies as a total endovascular aortic repair or combined with partial supra-aortic debranching. So far, only few data of perioperative and short-term to midterm results of in situ fenestration for proximal aortic arch aneurysms are available, although an increasing number of patients were recently reported.[5-11] However, long-term results are missing. Therefore, we report chronologically the second patient treated by in situ aortic arch stent graft fenestration for an aortic arch aneurysm with probably the longest follow-up period available so far and emphasize the need for regular long-term surveillance.

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Author conflict of interest: P.M.K. is consultant for Cook Medical, W. L. Gore & Associates, BARD, and Aptus.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214

http://dx.doi.org/10.1016/j.jvs.2016.05.072

CASE REPORT

A 61-year-old man with a 7.1-cm-diameter aortic arch aneurysm located at the inner curvature of the aortic arch was treated by in situ aortic stent graft fenestration for antegrade perfusion of the brachiocephalic trunk and the left CCA (Fig 1). The patient underwent an aortocoronary bypass operation 1 year before that included a left mammary artery bypass. The patient was considered unfit for reoperation with open aortic arch repair, and informed consent was obtained for this off-label procedure.

Before the intended endovascular aortic arch intervention, the patient received a left carotid-subclavian bypass. During the endovascular aortic arch intervention, cerebral perfusion was maintained by extracorporal circulation with bypass to the left axillary artery and the right CCA under moderate hypothermia of 31°C. In situ fenestrations in the tapered aortic stent graft implanted into the aortic arch (Cook Zenith 42-38 mm, 153 mm; Cook Europe, Bjaeverskov, Denmark) were performed by insertion of short 8F sheaths into both CCAs and puncture of the aortic arch stent graft with 18-gauge 18-cm access needles (Cook Europe) under fluoroscopic control with different planes perpendicular to the stent graft. The puncture sites were then dilated using a 4-mm high-pressure balloon, a 6-mm cutting balloon for the left CCA and another 8-mm high-pressure balloon for the brachiocephalic trunk.

For implantation of the connecting stent grafts, two 12- × 41-mm Advanta V12 stent grafts (Maquet, Rastatt, Germany) were used and aligned with a 12- × 25-mm Express stent (Boston Scientific, Ratingen, Germany) for the brachiocephalic trunk and a 7- × 38-mm Advanta stent graft for the left CCA, additionally aligned with an 8- × 18-mm Genesis Palmaz stent (Cordis, Fremont, Calif; Fig 2).

Time of extracorporal perfusion to the left axillary artery was 260 minutes and to the right CCA was 200 minutes, with a flow of 350 to 500 mL/min. The patient's postoperative outcome was uneventful, and he was discharged after 8 days with complete aneurysm exclusion, absence of endoleak, and without neurologic complications. The patient had follow-up examinations after 6 months and then at yearly intervals.

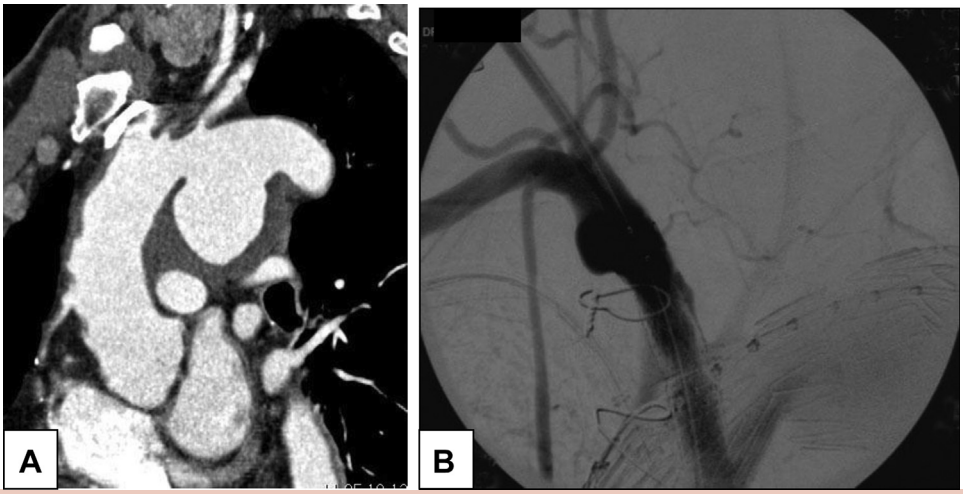

Fig 1. A, Excentric aortic arch aneurysm with a diameter of 7.1 cm located at the inner site of the aortic arch. **B,** In situ fenestration via the right common carotid artery (CCA) with balloon dilatation and implantation of connecting covered stent graft into the brachiocephalic trunk for antegrade supraaortic perfusion.

A computed tomography angiogram after 5 years showed a dilatation and elongation of the proximal descending aorta with nonalignment of the distal aortic stent graft requiring aortic stent graft extension using a custom made 40-36-92-mm endograft further extended with a 42- × 36- × 160-mm stent graft (both Cook, Zenith ZDEG stent grafts; Fig 3). Patient consent was obtained for this case presentation.

DISCUSSION

The first patient treated by in situ aortic arch fenestrations for an aneurysm of the aortic arch was reported by Sonesson et al[5] in 2009, with successful aneurysm exclusion of a patient with a ruptured aortic arch plaque. According to the literature, 13 patients were treated by in situ stent graft fenestration for aortic arch aneurysms with total or partial endovascular aortic arch repair at six different institutions between 2009 and 2015.[5-11] Most patients treated so far were single interventions and published as a case report. Just recently, the largest patient series was reported with seven patients treated by in situ aortic arch fenestrations, four of them performed as complete endovascular aortic arch repair.[10] Interestingly, the authors have treated three patients by in situ aortic arch stent graft fenestration with intimal tears in the ascending aorta.

What are the indications to use in situ aortic arch fenestration in times of upcoming procedures such as inner branch endografts, aortic arch chimney procedures, and ascending aortic bypass to supra-aortic arteries with partial sternotomy and supra-aortic debranching? As a less invasive endovascular procedure, aortic arch in situ stent graft fenestration is an option in emergency procures when custom-made endografts are not available or in patients with large ascending aortic diameters or a short proximal landing zone in the ascending aorta where chimney graft interventions are not suitable.

Fig 2. Three-dimensional reconstruction of the aortic arch after in situ aortic arch stent graft fenestration with patent connecting stent grafts to the brachiocephalic trunk and the left common carotid artery (CCA). In addition, the patient has received a left carotid-to-subclavian bypass for perfusion of the left vertebral artery, a left mammary artery coronary bypass, and an Amplatzer plug (St. Jude Medical Inc, St. Paul, Minn) for left subclavian artery (LSA) perfusion with proximal occlusion.

However, in situ fenestrated stent grafts are at an increased risk for type III endoleaks because the connecting stent graft has only a very short zone for sealing and requires a close apposition to the aortic wall. Therefore, in situ fenestration within the aortic arch is recommended only for aortic pathologies or aneurysms located at the inner curvature of the aortic arch with alignment and apposition of the stent graft at the outer curve of the aorta.[3,8,10] Because relevant data on durability and long-