**Case
Report**

Open Stent Grafting with a Trifurcated Graft for an Infected Aortic Arch Aneurysm Concomitant with Severe Calcified Aorta

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An infected aortic arch aneurysm is a rare but life-threatening condition. Moreover, surgical treatment for patients with severe calcified aorta is challenging and needs a well-planned strategy. We report a patient with an infected aortic arch aneurysm concomitant with severe calcification of the aorta in whom good results were obtained with open stent grafting in combination with a trifurcated graft.

Keywords: infected aortic aneurysm, open stent grafting, trifurcated graft, severe calcified aorta

Introduction

Infected aortic aneurysms are a rare subset (0.65%–1.3%) of all aortic aneurysms, but are highly lethal.^{1,2)} The standard treatment strategy remains surgical resection and extensive debridement of the infected aorta and the surrounding tissue, the use of the omentum to cover the infected field and either an in-situ interposition graft or extra-anatomical bypass followed by administration of antibiotics. However, operative mortality still remains high at 13.3%–44%.^{2,3)} Moreover, surgical treatment for patients with severe calcified aorta is challenging and needs a well-planned strategy. We report an open stent grafting in combination with a trifurcated graft for the treatment of an infected aortic arch aneurysm concomitant with severe calcification of the aorta.

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Case Report

A 54-year-old man was admitted to our hospital with persistent pyrexia and chest pain. On admission, the patient appeared ill with a temperature of 38.4°C, a pulse rate 110 beats per minute and blood pressure 100/52 mmHg. He had been on hemodialysis 3 times a week for 15 yrs due to chronic renal failure. Chest radiography revealed bilateral pulmonary effusion. Laboratory data showed a C-reactive protein level of 11.5 mg/dl (normal, <0.3 mg/dl), and progressive leucocytosis of 9700/mm³ (normal range, 4000–8000/mm³). Arterial blood culture yielded no microorganisms and transthoracic echocardiography showed normal cardiac chambers and a valve architecture with no vegetation. A computed tomography (CT) scan showed an inflamed, thickened aneurismal wall and pseudoaneurysm in the distal part of the aortic arch with severe calcification of the aortic wall (**Fig. 1**). He underwent emergency surgery under a diagnosis of rupture of the infected aortic arch aneurysm. Both axillary arteries were exposed and anastomosed with 10 mm-diameter synthetic grafts as outflow cannulation. After a median sternotomy, cardiopulmonary bypass was established and right axillary arterial perfusion was used. During hypothermia at a rectal temperature of 25°C, and antegrade cerebral perfusion with both axillary arterial grafts for brain protection, we transected the middle site of the ascending aorta because

Fig. 1 (a) Computed tomography (CT) reveals an inflamed and thickened aneurysmal wall (arrow). (b), (c) Computed tomography (CT) reveals a pseudoaneurysm at the end of the aortic arch complicated with severe calcified aorta.

of severe calcified aorta, then arterial perfusion of the left common carotid was selectively begun. A stent graft, which was constructed from a 30×50 -mm self-expandable Gianturco Z-shaped stent (William Cook Europe, Bjaeverskov, Denmark) with the distal part covered with a 28-mm collagen-coated woven Dacron graft, was delivered into the descending aorta by using exclusive delivery forceps, with the distal end located about 6 cm below the aneurysm, under monitoring with a transesophageal echocardiography and an endoscope into the aorta. The proximal end of the stent graft was sutured to the wall of the transected ascending aorta. After sizing the innominate, left common carotid and left subclavian arteries, a trifurcation graft was constructed by sewing two 8-mm branches to a 12-mm graft. The proximal site of this 12-mm graft was anastomosed to the proximal ascending aorta to avoid calcification of the aortic wall. The distal site of the 12-mm graft was anastomosed to the brachiocephalic trunk.

Next, the first of the 8-mm limbs was anastomosed to the transected left common carotid artery, and finally the second side branch of the trifurcated graft was sutured to the left subclavian artery. Surgical, cardiopulmonary bypass, and selective cerebral perfusion times were 450 min, 325 min, and 70 min, respectively. On postoperative day 1, the patient was weaned from the respirator and on postoperative day 3, hemodialysis was resumed. Intravenous antibiotic (Ceftriaxone sodium hydrate, 1 gram per day) was administered until substituting for the oral antibiotic. Thus, the postoperative course was essentially good despite transit left hemiparesis, with no significant abnormal findings on brain magnetic resonance imaging (MRI). Postoperative angiography and CT scan showed that the aortic pseudoaneurysm had disappeared and the trifurcated graft was completely patent two months after the operation (**Fig. 2**). He took oral antibiotics, which were an empiric regimen, for two years. He has remained

Fig. 2 (a), (b) Postoperative thoracic DSA angiography (a) and three-dimensional CT (3DCT) (b) show that the pseudoaneurysm of the aortic arch has disappeared by the stent graft and the trifurcated graft is completely patent.

alive without recurrence for 32 months after the operation.

Discussion

An infected aortic aneurysm is rare but usually fatal, with a high risk of expansion and rupture.¹⁻³⁾ The standard treatment of resection of the infected aorta with aggressive debridement of periaortic tissues followed by reconstruction of the aortic flow in-situ or extra-anatomically is associated with a high morbidity and mortality rate. Therefore, surgical treatments for infected aortic aneurysms remain challenging and controversial. Recently, several reports have been published that endovascular stent graft treatment for infected aortic aneurysms provided acceptable short- and medium-term results in patients without fistula complications.^{4,5)} Kritpracha et al. reported that the prognosis of their patients with an infected aortic aneurysm complicated with a fistulous connection with an adjacent organ such as the gastrointestinal tract or lower respiratory tract was poor. They reported that the mortality rates of the fistulous group and nonfistulous group were 60% vs. 6% perioperatively, and 50% vs. 0% during follow-up. Therefore, they concluded that the presentation of fistulous connections with adjacent organs which failed to improve after endovascular therapy signified a poor prognosis in patients with an infected aortic aneurysm. In the present case, the patient had an infectious pseudoaneurysm on the distal aortic arch at the distal side of the left subclavian artery with severe calcified aortic wall, and then application of usual vascular prosthesis

implantation was considered inappropriate. Therefore, total aortic arch replacement was performed with a stent graft applied in the distal side of the implantation to prevent rupture of aneurysm. Artificial materials in an infection focus are contraindicated in principle. Recent several reports have shown⁴⁻⁶⁾ that a patient having a legion accompanied with fistula to other organs such as the digestive tract has a poor prognosis, and stent-graft treatment should not be considered as a radical therapy in patients with fistula although this treatment procedure may be considered as a bridge to more definitive surgical treatment after achieving hemodynamic stabilization. In this our case, the lesion had no fistula to other organs, and causative organism, although it was not identified, was relatively antibiotic-sensitive, different from highly-virulent bacteria such as MRSA, which seems to have allowed for the patient's favorable outcome over a medium period. Moreover, as the infected aneurysm was limited to the distal aortic arch, the aortic wall at the site of stent graft placement was little affected by inflammation, which seems to have allowed for the closely-attachment of the stent graft to the aortic wall and no endoleak through the distal site of the stent graft (i.e. type III endoleak). Once stent graft exclusion of the infected aneurysm is completely successful, some aneurysms without fistula might be thrombosed and absorbed. Obviously, a close follow-up for relapsing of infection should be required.

Recent advances in thoracic stent-graft technology have enhanced the management of diseases of the descending thoracic aorta by avoiding thoracotomy and have expanded the group of patients eligible for treatment. However, endovascular stent grafting for aortic arch diseases involving the distal arch is still in the early stage of development.⁷⁾ Open stent grafting is advantageous because it is less invasive, requiring distal anastomosis rather than conventional replacement, especially for those patients with severe calcified aorta.⁸⁾ In this case, we could not avoid transecting and endovascular stent-grafting via the proximal ascending aorta because of severe calcification of the aortic arch. A trifurcated graft⁹⁾ was very useful for creating inflow from the proximal ascending aorta to debranch the innominate artery, left common carotid artery and left subclavian artery with concomitant antegrade stent graft insertion across the aortic arch.

In conclusion, open stent grafting in combination with a trifurcated graft for an infected aortic arch aneurysm might be a beneficial alternative to

conventional surgical care, and a trifurcated graft is useful for debranching the brachiocephalic vessels, especially for patients complicated with severe aortic calcification.

Disclosure Statement

The authors declare no conflicts of interest. The authors had no financial assistance in the writing of this manuscript.

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