Case Report

AORTA

Aorta, September 2013, Volume 1, Issue 4: 227–230
DOI: http://dx.doi.org/10.12945/j.aorta.2013.13-037

Received: August 2, 2013
Accepted: September 20, 2013
Published online: September 2013

A Single-Stage Repair of Arch and Descending Thoracic Aortic Aneurysms Using Jotec E-vita Open Plus Hybrid Stent Graft Combined With Antegrade Deployment of Thoracic Endograft

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Abstract

We report a unique case of a 63-year-old female with extensive peripheral vascular disease who underwent a single-stage surgical repair of the aortic arch and descending thoracic aortic aneurysm utilizing the Jotec E-vita Open Plus hybrid stent graft system combined with antegrade deployment of a thoracic endograft via a median sternotomy.

Key Words

Aorta/aortic · Aortic arch · Aortic operation · Endovascular procedures/stents

Introduction

A two-stage approach is required to surgically treat the aortic arch, mid and distal descending thoracic aortic (DTA) aneurysm. Initially, the aorta in the ascending and arch portion is repaired through a median sternotomy, followed by graft replacement of the descending aorta through left thoracotomy at second stage. In 1994, Dake et al. [1] introduced endovascular stent graft technology to manage thoracic aortic aneurysm. These two techniques have been combined as well, to achieve complete treatment of complex aneurysms in a single stage.

Case Report

A 63-year-old lady, a current heavy smoker, hypertensive, non-insulin-dependent diabetic with extensive peripheral vascular disease (PVD), was incidentally found to have a complex thoracic aortic aneurysm during routine investigations for chest infection. Initial computed tomography (CT) angiogram revealed two separate aneurysms: one involving the distal aortic arch and proximal DTA and another distally in the DTA. The rest of the aorta was of normal caliber. Initially, a strategy for conservative management was adopted due to high risk of intervention on

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Published by Science International Corp.
ISSN 2325-4637

Accessible online at:
http://aorta.scienceinternational.org

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Figure 1. Reformatted 3D CT image showing separate thoracic aneurysms and extensive calcification of small iliac arteries.

account of her comorbidities. However, the aneurysms grew to 5.9 cm (previously 4.7 cm) at the distal arch and 8.1 cm at the distal DTA (previously 6.4 cm; Fig. 1). Both ilio-femoral systems were small, calcified, and extensively atheromatous.

A coronary angiogram demonstrated a distal 50% stenosis in the left main stem, along with significant triple vessel coronary artery disease. The left ventricular (LV) function was good. Pulmonary function tests revealed a forced vital capacity (FVC) of 86%, forced expiratory volume at the end of 1 s (FEV_1) of 82%, and FEV_1/FVC of 102%. Transthoracic echocardiogram revealed no valvulopathy.

The patient's case was discussed at our thoracic aortic multidisciplinary meeting. A single-stage procedure via a median sternotomy was planned, thus avoiding a thoracotomy in the future and risk of respiratory complications considering the fact that she remained a very heavy smoker despite persistent counseling. With extensive PVD precluding retrograde delivery of a thoracic endograft, antegrade deployment of a stent graft was planned via the ascending aorta.

Two antegrade punctures were performed in the ascending aorta with one being utilized by an imaging catheter. Through the other puncture, a 0.035 guide wire was passed under fluoroscopic guidance into the visceral abdominal aorta and exchanged with a Lunderquist stiff guide wire. A Gore DrySeal sheath (GORE®, Flagstaff, Arizona, USA) was then introduced and negotiated around the arch. A 28 mm diameter × 15 cm length device was deployed with the distal end just above the celiac axis. A second 31 mm × 15 cm length Gore TAG device (GORE®, Flagstaff, Arizona, USA) was deployed with adequate overlap with its proximal end just distal to the proximal DTA (Figs. 2 and 3). For spinal cord monitoring and protection, a cerebrospinal fluid drain and motor evoked potential monitoring were used. Cardiopulmonary bypass (CPB) was established with an 8 mm Dacron tube graft anastomosed to the right axillary artery (RXA) and two-stage venous cannulation. The LV was vented through the right superior pulmonary vein. Once the bladder temperature was 20°C, the circulation was arrested. The ascending aorta was opened and antegrade cerebral perfusion (ACP) was commenced via the RXA for the right side and direct left common carotid artery (LCCA) cannulation. Antegrade cerebral perfusion was utilized at the flow rate of 8-10 mL/kg/min. The origin of the left subclavian artery (LSA) was harvested as a button and the innominate and LCCA were harvested as an island patch. A 10 mm Dacron tube graft was anastomosed end-to-end to the origin of the LSA. Fol-

Figure 2. Subtracted angiographic image after antegrade deployment of both Gore TAG stent-grafts.

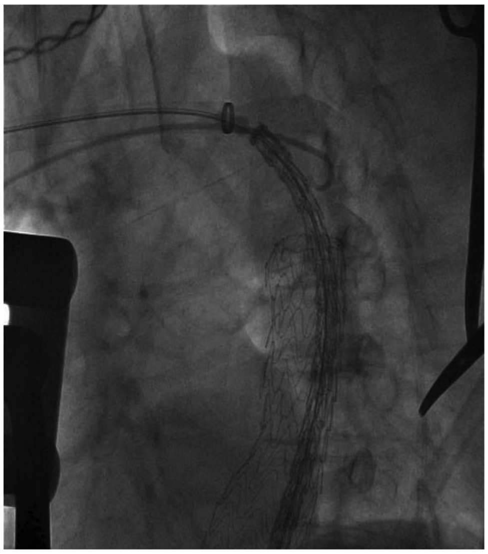

Figure 3. Fluoroscopic image just before deployment of the second Gore TAG stent-graft. A separate pigtail catheter for angiography can also be seen.

lowing this, the frozen elephant trunk (JOTEC E-vita open plus, JOTEC, Hechingen, Germany) was introduced over a guide wire into DTA ensuring adequate overlap with the previously placed endograft. Anastomosis of the fabric part of the graft was done to the aorta just distal to the origin of LSA. The island patch with the origin of the two remaining arch vessels was anastomosed to a suitable location on the arch graft. Circulation and rewarming were commenced. Three lengths of saphenous vein were grafted onto the posterior descending artery-right coronary artery (PDA-RCA), second obtuse marginal (OM_2), and left anterior descending (LAD) arteries. The proximal end of the arch graft was anastomosed to the ascending aorta just above the sino-tubular junction. The proximal end of the 10 mm graft to the LSA was anastomosed to the ascending aortic graft. The top ends of the vein grafts were anastomosed to the Dacron grafts. Overall aortic cross clamp time was 288 min, CPB time 444 min, ACP 155 min, and circulatory arrest time 155 min. On completion, the heart was weaned off CPB with good hemodynamics and sinus rhythm. The patient required modest use of vasopressor support and received 4 U of whole blood transfusion.

Postoperatively, the patient required a percutaneous tracheostomy, close respiratory nursing, and physiotherapy. Her overall hemodynamic status was stable,

Figure 4. Reformatted postoperative 3D image showing the sternotomy, coronary grafts, left subclavian bypass, and aortic suture line. The top ribs of the Jotec E-vita stent-graft are seen above the Gore TAG grafts, which extends to just above the celiac axis.

and she progressed well and remained neurologically intact. Eventually, she was discharged home safely and has attended the follow-up clinics three times over a 9-month period. She remains independent and has a good quality of life.

Discussion

In this case report, the patient required a single-stage surgical intervention to repair the distal arch and DTA aneurysms, taking into consideration her smoking status, extensive PVD, the relatively rapid increase in size of aneurysms, and the need for coronary revascularization. Hence, a single-stage repair of arch and descending thoracic aortic aneurysms using Jotec E-vita Open Plus hybrid stent graft combined with antegrade deployment of thoracic endograft was performed (Fig. 4).

Azizzadeh et al. [2] reported a case in which the ascending, arch, and descending thoracic aneurysms were treated surgically in similar hybrid: the ascending and arch of the aorta were repaired with conventional Elephant trunk (ET) followed by antegrade placement of a stent graft to repair the DTA. In their case, however, a conventional ET was used contrary to our utilization of the Jotec E-vita Open Plus hybrid stent graft for aortic arch repair, which was preceded by antegrade deployment of thoracic endograft for the DTA.

Several groups have postulated endovascular treatment of the arch after debranching and extra-anatomic bypass of the head and neck vessels [3]. The advantages here are avoidance of CPB use and associated circulatory arrest. Although aortic debranching and stenting could have been an option, we did not use this strategy as there was no possibility of retrograde deployment of a stent into the descending thoracic aorta, across the arch and into the ascending aorta due to extensive peripheral vascular disease involving not only the ileo-femoral system on both sides, but also the distal ascending aorta. Moreover, Lee et al. [4] found no superiority of the debranching procedure over the standard ET procedure. There is little data about long-term follow-up of the debranching procedure of total arch with associated stenting.

Conclusion

We demonstrate the feasibility of a single-stage hybrid approach to the management of arch and DTA aortic aneurysms using a combined Jotec E-vita Open Plus hybrid graft and thoracic endovascular aneurysm repair, minimizing the mortality and morbidity risks.

Comment on this Article or Ask a Question

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Cite this article as: Bashir M, Fok M, McWilliams RG, Desmond M, Field M, Fisher RK, Oo A, Kuduvalli M. A Single-Stage Repair of Arch and Descending Thoracic Aortic Aneurysms Using Jotec E-vita Open Plus Hybrid Stent Graft Combined With Antegrade Deployment of Thoracic Endograft. Aorta 2013;1(4):227–230. DOI: http://dx.doi.org/10.12945/j.aorta.2013.13-037

EDITOR'S QUESTIONS

1. As the arch proper was normal, did you really need to do a total arch replacement?

The arch was not entirely normal and the distal arch around the origin of the left subclavian artery and the proximal descending thoracic aorta were aneurysmal. Not replacing the whole arch would have required suturing of the E-Vita prosthesis at the level just after the origin of the left common carotid artery into reasonably diseased aorta, with little space between that area and the origin of the left common carotid artery itself. We felt replacing the whole arch would present less technical challenges compared with the above option.