Masters of Cardiothoracic Surgery

Facilitated surgical strategy in total arch replacement and descending aorta stent grafting with the E-vita open hybrid prosthesis

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Submitted Jul 19, 2013. Accepted for publication Sep 23, 2013.
doi: 10.3978/j.issn.2225-319X.2013.09.15
Scan to your mobile device or view this article at: http://www.annalscts.com/article/view/2728/3591

Clinical vignette

The patient is a 69-year-old male with a symptomatic, fusiform distal arch/proximal descending aortic aneurysm extending over 9 cm in length. As demonstrated in the CT-scan, the distal arch aneurysm is 5.5 cm diameter with a newly detected symptomatic ventral sac extending to 6 cm in diameter, presenting as a penetrating aortic ulcer (PAU). The ascending aorta is ectatic to 4.5 cm. His risk factors include arterial hypertension and a stroke in 1994 without residual effects.

Surgical techniques

After exposure of the right axillary artery (not demonstrated in *video 1*) and standard median sternotomy, the aortic arch was exposed after a tape was passed around the innominate vein. The innominate artery was taped and an umbilical tape snare was placed around the left common carotid artery (LCCA). After heparinization and cannulation of the right axillary artery and right atrium a left ventricular vent was inserted via the right upper pulmonary vein. While cooling to a bladder temperature of 25 ℃, the left subclavian artery (LSA) was exposed and encircled with a tape as well. With gentle downward traction, the LSA was clamped distally and proximally and transected. A 10 mm Dacron (Vascutec Ltd, Renfrewshire, Scotland) prosthesis was anastomosed end-to-end to the distal LSA using a 5-0 polypropylene suture. Subsequently the LSA stump was oversewn with a Teflon pledgeted polypropylene 2-0 suture. The prosthesis was then connected with a separate roller pump and perfused at a pressure of 50-60 mmHg. After reverse cross clamping, 1,600 mL of Bretschneider solution (Custodiol, Köhler Chemie GmbH, Bensheim, Germany) was infused and the distal ascending aorta was transected.

Arch exposure and angioscopic evaluation of the aneurysm

First, the LCCA was cannulated and perfused using the same roller pump as the right axillary artery. The perfusate temperature was 18 ℃ at a flow of 12-15 mL/kg/min, keeping perfusion pressure between 50-60 mmHg. The atherosclerotic arch was resected to its distal circumference close to the LSA origin, while the arterial trunk and LCCA were excised as an island and exposed with a traction suture. Using continuous sump suction within the descending aorta, angioscopy was performed to determine the extent of the atherosclerotic zone. At the level of the previously introduced pigtail catheter, a large thrombus-covered area was detected as well as multiple atherosclerotic ulcers and craters. Since the length of the heavily sclerotic region was 13 cm from the LSA origin, the 13 cm long stented portion of the E-vita hybrid graft (Jotec GmbH, Hechingen, Germany) was introduced roughly 15 cm to safely cover the thrombus part without shearing off debris. The diameter of the landing zone distally was 32 mm, and therefore a size 33 mm E-vita open graft was chosen.

Insertion of the hybrid graft and arch reconstruction

After measuring the distance to be covered by the stent

graft, insertion was performed over a stiff guide wire inside the pig tail catheter. The graft was subsequently released, the introducer removed, the stiff guide wire retracted back into the pig tail catheter and the intussuscepted arch graft pulled out by approximately 1 cm. This was followed by an end-to-side anastomosis with the transected distal arch using a 3-0 polypropylene suture secured with an external Teflon felt strip. Angioscopy demonstrated full coverage of the large mural thrombus by the stent graft as well as its full expansion. The LCCA and arterial trunk island were separated and sequentially reanastomosed to the arch graft using 5-0 polypropylene suture after creating equivalent anastomotic holes in the arch graft with an ophthalmic disposable cautery. After deairing, whole body circulation and rewarming was started after 43 min of visceral ischemic time with SACP.

Ascending aortic replacement, prosthetic reunion and reimplantation of the LSA graft to the arch prosthesis

Resection of the ascending aorta close to the sinotubular junction and an end-to-end anastomosis with a 32 mm polyester prosthesis (Vascutec Ltd, Renfrewshire, Scotland) was performed using a 3-0 polypropylene suture reinforced by external Teflon felt. Both prostheses were subsequently joined using a 4-0 polypropylene continuous suture technique. The aortic cross clamp was removed after deairing with continuous left ventricular and aortic venting after 68 minutes of cardiac arrest. Finally, the extra-anatomic LSA graft was anastomosed via a retroaortic route onto the arch graft, again using a 5-0 polypropylene suture technique. Total cardiopulmonary bypass (CPB) time was 198 minutes.

Cite this article as: Jakob H. Facilitated surgical strategy in total arch replacement and descending aorta stent grafting with the E-vita open hybrid prosthesis. Ann Cardiothorac Surg 2013;2(5):663-664. doi: 10.3978/j.issn.2225-319X.2013.09.15

Follow up

At 3 months, the patient is doing well and follow-up imaging is without pathologic findings.

Comments

The E-vita open principle relying on a proximal hemostatic suture line and stent grafting of the descending aorta has proven to create a stable situation over a follow-up time of up to 8 years at our center, without any proximal endoleaks in a one-stage repair of complex thoracic aortic disease. However, the extent of surgery remains large with long hypothermic arrest and SACP times. Thus, the primary transection of the LSA during cooling and connection to an extra-anatomic Dacron graft gives the following advantages:

(I) Simultaneous perfusion of all epiaortic vessels hopefully leading to improved spinal cord protection in acute and chronic dissection as well as aneurysmal disease;

(II) Moving of the hybrid graft suture line from Zone 3 to Zone 2, allowing the avoidance of the left recurrent laryngeal nerve and facilitating the anastomosis at mid-arch position;

(III)Reduction of hypothermic circulatory arrest and SACP times by one third;

(IV) Easier hemostasis after cessation of CPB.

Acknowledgements

Disclosure: The author declares a conflict of interest as having a financial relationship to Jotec GmbH, Hechingen, Germany.

