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CASE REPORT

Endovascular treatment of recurring type A dissection after total aortic arch debranching

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Abstract Standard treatment method of the aortic arch pathologies is surgical replacement which requires cardiopulmonary bypass and deep hypothermic circulatory arrest. However, this approach is associated with major operative risks. Combination of debranching and thoracic endovascular aortic arch repair (TEVAR) has emerged as an alternative treatment modality in high-risk patients. This report describes successful staged hybrid treatment of a 50-year-old male patient with recurring type A dissection. It is concluded that staged debranching and TEVAR is a feasible option and provides aortic repair without increase of risk.

Keywords Aortic dissection · Endovascular treatment · Hybrid treatment

Introduction

So far, standard therapy of recurrent type A dissections is open surgical repair requiring cardiopulmonary bypass and exposure of the previously operated aortic segments, with the risks of injury to the adjacent nerves, bleeding and paraplegia. Aortic arch replacement requires deep hypothermic circulatory arrest, exposing the patient to the risk of cerebrovascular complications. Despite significant improvements, morbidity and mortality of open surgery remain high [1]. Thoracic endovascular aortic arch repair (TEVAR) has emerged as an alternative treatment modality in high-risk patients [2]. Aortic arch pathologies, such as dissections and aneurysms, often involve supra-aortic vessels. Therefore, it may be necessary to cover the origin of these vessels with endovascular stent grafts, thereby extending the proximal landing zone. Surgical aortic arch debranching is indicated before covering the brachiocephalic trunk or left common carotid artery by endovascular stent grafts [3]. Here, we report successful staged hybrid treatment of a patient with recurring type A dissection.

Case report

A 50-year-old male patient who had an ascending aorta replacement, due to type A dissection 4 years ago, was admitted to our clinic with the symptoms of shortness of breath, dysphasia, and faint. On his physical examination, blood pressure was 160/80 mmHg. Cardiac auscultation revealed a rhythmic tachycardia with no additional heart sounds. Electrocardiography showed sinus tachycardia and signs of left ventricular hypertrophy. The chest roentgenogram showed widened upper mediastinum and increased cardiothoracic ratio. Transthoracic echocardiography revealed dilatation of ascending aorta with no additional finding. Urgent computerized tomography showed recurrent dissection starting from the distal anastomosis line of the old graft at the ascending aorta and extending to the

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Fig. 1 CT scan demonstrates recurring type A dissection located in the arcus aorta

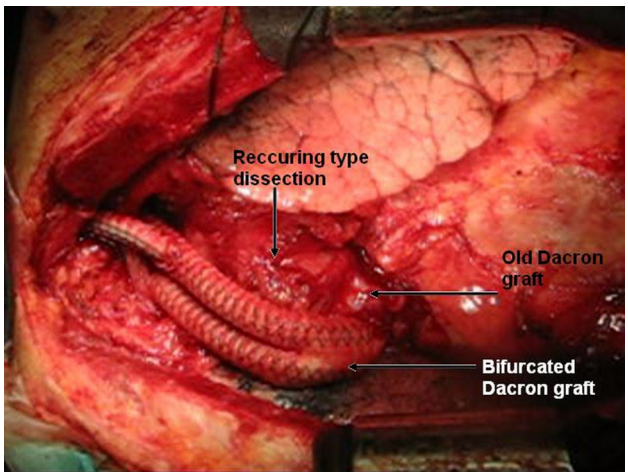

Fig. 2 Intraoperative view of completed debranching with bifurcated graft from the ascending aorta to innominate artery and left common carotid artery and left subclavian artery to the bifurcated graft

arcus aorta by involving orifices of the supra-aortic vessels (Fig. 1). We decided to adopt two-step surgical approach. First step, debranching the supra-aortic vessels to the old Dacron graft then to treat his recurring aneurysm with endovascular therapy 2 days later.

Debranching method

A midline sternotomy was performed using oscillating saw. Dense adhesions due to previous operation were dissected over the ascending aorta and myocardium. Old supra-coronary tubular 24 mm in diameter Dacron graft was exposed at the proximal aorta extending just below the innominate artery and dissection carried out through the aortic arch and its branches. After systemic heparinisation, Dacron graft at the ascending aorta was partially clamped with a side-biting clamp and a longitudinal incision performed. An end-to-side anastomosis between the proximal part of a bifurcated graft (14 × 7 mm Gelseal, Vascutek, Renfrewshire, Scotland) and Dacron graft at the ascending aorta was performed using a continuous 3/0 polypropylene suture. The cross clamp was removed by de-airing from the graft. The innominate artery was then partially clamped and an end-to-side graft performed with the first limb, and an end-to-end anastomosis was performed. After this the left common carotid anastomosis was made as the same fashion. Left subclavian artery was dissected via left supra clavicular approach and end-to-side anastomosis was performed with 7-mm straight Dacron graft. Then, the graft was passed under subclavicular region through the mediastinum and end-to-side anastomosis was made over the bifurcated graft (Fig. 2). Following this, all the branch vessels are ligated proximal to the grafting area to prevent a Type II endoleak.

Endovascular aortic arch repair

A commercial endovascular stent graft (ESG) device was selected according to length, required diameter and anatomical findings. The ESG diameter was calculated from the largest proximal neck diameter with an oversizing factor of 15 %. The ESG devices were implanted in the angiography suite, under local anesthesia, and via femoral artery cutdown. The ESGs (28-mm diameter and 170-mm length E-vita Thoracic Straight Open Design, Jotec Inc, Hechingen, Germany) were advanced under fluoroscopic guidance and deployed during systemic hypotension (systolic BP 50–60 mmHg) induced by rapid cardiac pacing (frequency 180–220/min) method (Fig. 3a, b). 30 mm overlapping was provided between the old 24-mm Dacron graft and 28-mm ESG. Latex balloon was used to improve expansion for modeling the ESG to the aortic wall.

Control aortogram of the entire aortic arch from ascending aorta to descending aorta showed patent debranching graft and no endoleak or immigration of the ESG. No immediate neurological complications occurred during either surgical or endovascular steps. The patient recovered well and discharged on fifth postoperative day. Control follow-up CT scan shows good position of the graft and the patient had no endoleak.

Discussion

Aneurysms of the transverse aortic arch, especially those involving the mid to distal arch, are technically challenging to repair with conventional open techniques and still carry

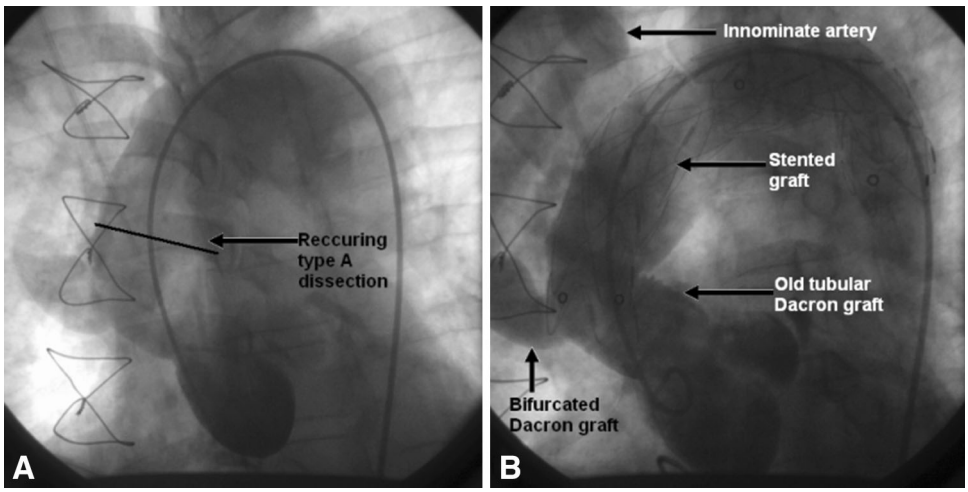

Fig. 3 **a** Angiography of the recurring type A dissection. **b** Final angiography showing the endovascular graft located in the arcus aorta and patent debranched supra-aortic vessels

a perioperative death or stroke rate approaching 15 %, even in experienced hands [4]. An alternative therapeutic option, hybrid repair consists of combined aortic branch vessel revascularization followed by TEVAR. This treatment modality has been reported to be safe and effective [5, 6]. The endovascular method requires suitable "landing zones" (3 cm of normal aortic wall) for ESG fixation [7]. In aortic arch pathologies, surgical bypass grafting prior to TEVAR is necessary to prevent ischemic or embolic events.

Experience with total arch debranching in conjunction with endovascular stent grafting is limited. Reasons for this are the novelty of the combined approach, and the paucity of patients with aortic arch disease who are potential candidates for this procedure. This patient was carrying high risk of mortality of morbidity with conventional method because of dense adhesions of the previous operation and extension of recurrent type A dissection.

Debranching can be performed partially or totally. Partial debranching consists of cervical incision and a carotid-to-carotid bypass graft [8] or a graft from the right carotid to left carotid and subclavian [9]. Total arch debranching is possible via an upper sternal split or complete sternotomy. Selection of the approach technique depends on the extension of the diseased aorta and debranching procedure. We use an inverted bifurcated graft from the ascending aorta to the innominate and left common carotid artery as reported by other authors [3]. It has been shown that it is not necessary to transpose the left subclavian artery unless it is diseased or not to have coronary bypass with left internal thoracic artery, but we bypassed using 7-mm Dacron tubular graft [3]. It may be thought that bypassing the left subclavian with the ligation may prevent Type II endoleaks. Weigang E and colleagues reported no endoleaks after covering the left subclavian with ESGs without ligating the left subclavian [7].

Proximal anastomosis of the bifurcated graft to the ascending aorta may be performed with side clamp without the backup of cardiopulmonary bypass. Surgeon should alert the anesthesiologist to lower the blood pressure to prevent clamp dislodgement, or damage by the clamp leading to dissection of the ascending aorta. In this case, we had an advantage of performing anastomosis at the Dacron graft. Indeed, this important complication has already been described during off-pump coronary bypass [10]. Cardiopulmonary bypass may be required in aneurysms also involving the ascending aorta where the graft may need to be placed much more proximal on the aorta. Following total arch debranching, markers (metal clips) were placed at the proximal anastomosis to the arch, to define the proximal extent of the proximal landing zone. Prior to deployment of the ESG, great care should be taken to prevent migration during deployment. Blood pressure is lowered to about 50–60 systolic using intravenous dilatators or rapid cardiac pacing as in this case.

Patients who received TEVAR are at risk of aortic rupture from endoleaks. Digital subtraction angiography (DSA) is the gold standard for detection of endoleaks after TEVAR, but multidetector CT has been shown to have good correlation with DSA in endoleak detection [11].

TEVAR in combination with supra-aortic transposition in high-risk cases represents an attractive concept with the potential to improve significantly the perioperative outcome. Using this method, the risks of prolonged cardiopulmonary bypass, deep hypothermia, circulatory arrest as well as the majority of surgical manipulations on the aortic arch are eliminated. This combined approach may turn out to be the preferred therapeutic modality to repair aortic arch lesions in patients with multiple co-morbidities who otherwise would not be candidates for a conventional operative repair. However, long-term follow-up is necessary to confirm the stability of this type of repair.

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