

Sun's procedure for chronic type A aortic dissection: total arch replacement using a tetrafurcate graft with stented elephant trunk implantation

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Introduction

The Sun's procedure is a surgical technique that integrates total arch replacement using a tetrafurcated graft with implantation of a special stented graft in the descending aorta, as a treatment option for extensive dissections or aneurysms involving the ascending aorta, aortic arch and descending aorta (1-3). To illustrate our technique for performing the Sun's procedure (1,2), we present a video of this approach in a 38-year-old man with chronic type A aortic dissection (*Video 1*).

Clinical vignette

The patient had a history of hypertension for twenty years and experienced an episode of chest and flank pain after exertion one year ago. Transthoracic echocardiogram detected dilated ascending aorta, aortic arch and descending aorta, as well as intimal flaps in the ascending aorta, and a dilated aortic root with severe regurgitation. Computed tomographic angiogram confirmed a chronic type A dissection, with the intimal tear in the ascending aorta, extending distally to the right iliac artery, and the arch vessels involved. Of note, the innominate artery was both aneurysmal and dissected for the entire length extending to the level of bifurcation. There was also a coronary anomaly, in which the left and right coronary arteries arose from the left coronary sinus. Considering the complex pathology of arch vessel involvement, innominate artery aneurysm, aortic root dilation with severe regurgitation and coronary artery anomaly, we decided to perform the Sun's procedure, in combination with

composite root replacement with a mechanical valved conduit.

Surgical techniques

The patient was placed in supine position. After induction of general anesthesia, the procedure was performed through a full median sternotomy, under cardiopulmonary bypass (CBP) with moderate hypothermic circulatory arrest at 25 °C, right axillary artery cannulation for CBP and selective antegrade cerebral perfusion.

Upon entry into the pericardium, the three arch vessels were exposed and surrounded. CPB was instituted through axillary artery cannulation and the right atrium, with left heart venting from the right superior pulmonary vein. The ascending aorta was clamped and opened longitudinally, where both the left and right coronary arteries were found to originate separately from the left coronary sinus. After cold blood cardioplegia was given, the free intimal flaps and aortic leaflets were resected and subsequently a valved conduit was sewn to the aortic annulus with a 3-0 running prolene suture. A big opening was made into the side of the graft for anastomosing the left and right coronary ostia, which was done by inclusion. When the patient was cooled to 25 °C, the aortic clamp was removed and bypass was now restricted to the axillary artery at 5 mL/kg/min. The arch vessels were clamped separately, selective cerebral perfusion was started, then the aortic arch was opened longitudinally. The left carotid artery was transected at its origin from the arch. The aortic arch was transected between

the left carotid artery and the left subclavian artery, which was transected 5 mm distal to its origin from the arch. The aneurysmal and dissected innominate artery was transected at its origins from the aortic arch.

As the initial step of Sun's procedure, the special stent graft was inserted into the descending aorta and deployed, taking only an instant and often in a matter of seconds.

Subsequently, the proximal sewing curtain of the stent graft was retrieved and exposed, and distal anastomosis was performed between the proximal end of the stent graft and a new 4-branched Dacron graft, which would be the new aortic arch, incorporating the wall of the aorta. At this point, distal perfusion was begun through the perfusion limb of the 4-branched graft, thus restoring lower body flow. Next, the left carotid artery was anastomosed to the second 8 mm arch branches from the graft in an end-to-end fashion. Now, rewarming was begun and left carotid artery was opened to flow after deairing.

The following steps were different from our routine sequence of anastomosis because the innominate artery was aneurysmal and dissected. The clamp on the innominate artery was moved upwards and the bifurcation was clamped, in order to enable complete resection of the innominate aneurysm and construction of the anastomosis. Cerebral perfusion at this stage was maintained only through the left carotid artery. After the innominate artery was anastomosed to the 1 cm arch limb of the 4-branched graft, it was opened to flow shortly after deairing, and bilateral cerebral perfusion was restored at this point. Then, proximal anastomosis was constructed by suturing the 4-branched graft to the distal end of the valved conduit. The proximal anastomosis was then constructed by suturing the 4-branched graft to the distal end of the valved conduit. The ascending aorta was now thoroughly deaired and unclamped, and the heart resumed beating. Finally, the left subclavian artery was anastomosed to the right 8 mm arch branch of the 4-branched graft.

The residual aortic tissues were approximated to cover the surgical site and to create a Cabrol fistula from the graft space to the right atrium. The extra perfusion limb of the four-branched graft was cut and oversewn, followed by weaning of the patient from CPB. Protamine was administered and the procedure was completed in a routine fashion. The patient had an uneventful recovery and was discharged 12 days postoperatively.

Comments

As of June 2013, our team has performed the Sun's procedure for 1,092 patients and achieved favorable early and late results (2-5). The overall in-hospital mortality rate was 6.27% (7.98% in emergent or urgent versus 3.98% in elective cases), and the

incidence of a second-stage procedure was 4% (4,5). At 42±18 months, complete thrombus formation around the stented graft was observed in 93% of patients with type A aortic dissection, extending to the diaphragmatic level in 70% (4). Our outcome is better than most contemporary reports.

Since its introduction, the indications of Sun's procedure have evolved considerably (3). Currently, this procedure is chiefly indicated in extensive dilating pathologies involving the ascending aorta, aortic arch and descending aorta (1,2). The Sun's procedure is now becoming increasingly widely applied globally, and "may become the next standard treatment in patients with type A aortic dissection involving repair of the aortic arch" (1,2,4).

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