

## Surgical Therapy for Annuloaortic Ectasia with David Procedure

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### Introduction

Denton Cooley introduced the term “annuloaortic ectasia” in 1961 to describe an aortic root aneurysm due to Erdheim’s cystic medial necrosis in patient without the stigmata of Marfan syndrome. Although annuloaortic ectasia is often associated with aortic root aneurysm, it may also occur in patients without aneurysm but aortic insufficiency with bicuspid or tricuspid aortic valve and in those with subaortic ventricular septal defect. Conversely, not all patients with aortic root aneurysm have annuloaortic ectasia. The term annuloaortic ectasia is now used to define a dilated aortic annulus, which is often encountered in patients with connective disorders of the aortic root. The aortic valve may be bicuspid or tricuspid.

Aortic valve-sparing operations were developed to preserve the native aortic valve in patients with aortic root aneurysms with or without aortic insufficiency, and also in patients with ascending aorta aneurysms with aortic insufficiency secondary to dilation of the sinotubular junction and relatively normal aortic cusps, annulus, and sinuses. This method helps to avoid the use of long-term anticoagulant (blood-thinner) medication and may reduce the risk of stroke or endocarditis. Now we report the first case of valve-sparing procedure in Hubei province.

### Case Report

A 36 year-old lady who is a house wife and have 11 years son reports to have a brother and sister who died due to Marfan syndrome, the later died in April 2007 then she sought attention at the peripheral hospital where she was referred to the Wuhan Union hospital where various investigations were taken. She neither smokes nor taking alcohol. She denies history of any illness in the past. Her mother died 27 years ago due to pulmonary tuberculosis. General/physical examination revealed a middle aged lady coherent and fully conscious in fair nutrition status. She was thin and tall, had long toes and fingers with crowded teeth. She had no pallor, pedal oedema or jaundice. She was afebrile.

**Cardiovascular system:** BP 100/70 mmHg, PR 65b/m regular and good volume, 1<sup>st</sup> and 2<sup>nd</sup> heart sounds-Normal. Respiratory system: RR 20b/min, symmetrical chest movement with vesicular breath sounds. Other Systems: CNS, SMS, GUS- were unremarkable.

Laboratory investigation included total bilirubin were 28.2 mMol/l,(9-20mMol/L), otherwise full blood picture, Liver function test, RFT,CRP,ASO,PT, stool and Urine results were normal. ECG was normal.

Chest x-ray showed an unfolded aorta,

**Echocardiogram Findings:** Ejection fraction was 65 %.

Ascending aorta and pulmonary artery are normal. Dilatation of sinuses of Valsava about 4.6cm and its inner diameter is 4.6cm, root of ascending aorta is 3.1cm, arch of aorta is 2.2cm in width, descending and thoracic aorta 1.5cm in width. Abdominal aorta 1.5 cm. Aortic valve and pulmonary valve are normal in function and morphology. Cardiac chambers, ventricular walls, mitral and tricuspid valves are unremarkable.

The diagnosis of Marfan syndrome and Annuloaortic ectasia (dilatation of sinus of valsava, dilatation of aortic annulus and ascending aortic aneurysm), NYHA class I-II, was reached and then elective operation was conducted.



**Figure 1.** CT angiography: revealed aortic root dilations without dissection.



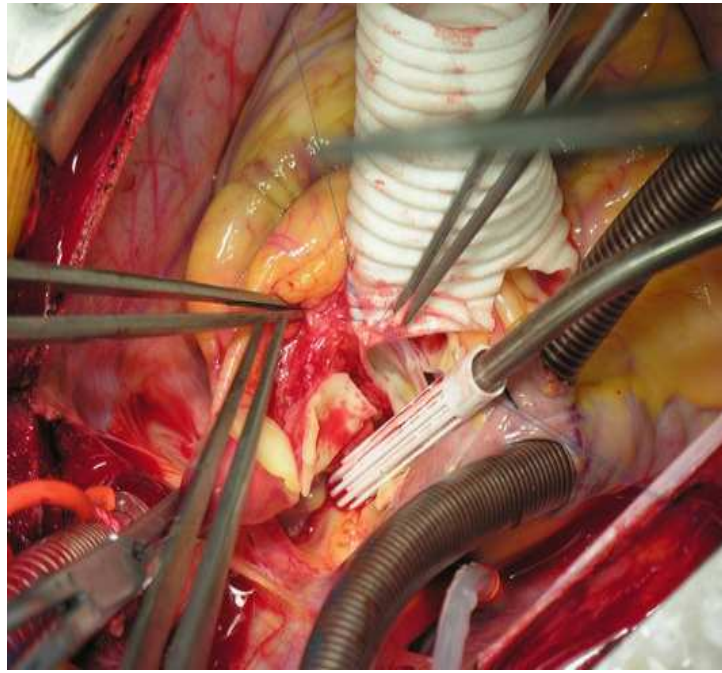
**Figure 2.**

**Operative findings:** aortic sinus dilatation about 4.6cm and aortic wall looks thin(friable).Ascending, arch and descending aorta, aortic valve are unremarkable, aortic motion and heart chambers were unremarkable. Valve ring is about 3.0cm.

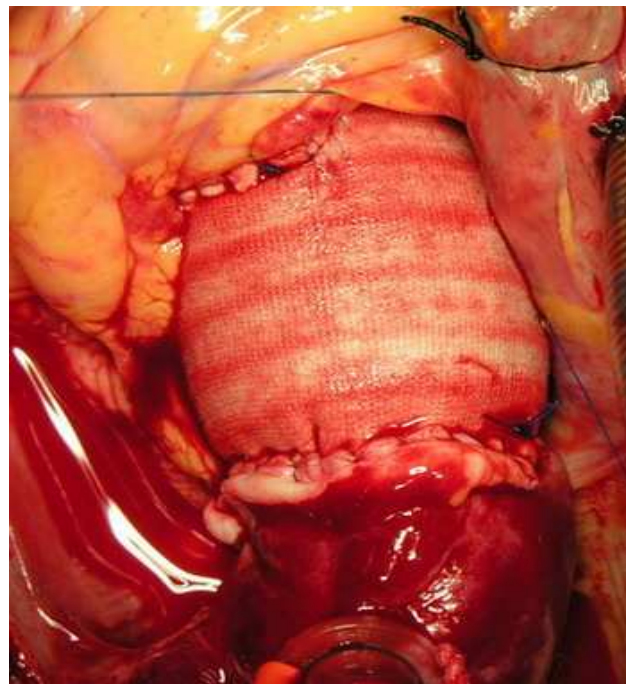
**Operative Technique:**

Medial sternotomy was performed and cardiopulmonary bypass was instituted with arterial cannulation through the ascending aorta and venous cannulation through bicaval cannulation. Myocardial protection was achieved by combination of antegrade cardioplegic solution and topical cooling with 4° saline solutions with intermittent antegrade blood perfusion. Heparin was administered prior to cannulation.

The graft end and root of aorta was scalloped as shown in fig 2-3. Fig 2 shows right and left coronary orifices with three commissures held on dissecting forceps.



**Figure 3.**



**Figure 4.**

Each aortic commissure was suspended to the respective positions in the graft (size #28) then anastomozed with continuous suture (5.0 prolene), three different sutures were used starting from each commissure, and these sutures were tied over a Teflon pledget. The sutures at the graft were sewn from outside to inside and at the arterial wall from inside to outside. These suture lines were aimed on maintaining hemostasis and remodelling of the aortic annulus into a smooth scallop shape. The valve was tested by injecting saline into the graft. Coronary arteries orifices are reimplanted into their respective sinuses. The distal end of the graft is sutured to the ascending aorta as shown in Figure 4.

*Postoperative care*

The patient was extubated after 12 hrs and the post operative period was uneventful. Patient was discharged ten days post operative after control Echocardiogram which showed normal parameters. The patient was maintained in aspirin for one month and long term  $\beta$ -blockers therapy. Clinical follow-up was updated by recent examination and phone contact.

## Discussion

Patients who have an ascending aortic aneurysm or annuloaortic ectasia, associated aortic regurgitation (AR) is common. Historically, conventional cardiovascular surgical treatment has been replacement of the entire aortic root (Bentall procedure). A mechanical valve is usually favored. Over the last 30 years, this procedure has proven to be a very low risk operation in specialized centers with extensive thoracic aortic surgical experience, and, indeed, a very durable one for patients with or without the Marfan syndrome (MFS).

On the other hand, some patients have medical contraindications making indefinite anticoagulation inadvisable, others are not medically compliant enough for anticoagulation to be safe, some individuals have life styles making anticoagulation hazardous, others do not have secured long-term access to health insurance or continuing medical care, some have an aversion to anticoagulation, and elderly patients do not need a new valve that will last for many decades. In these relatively infrequent circumstances, the aortic root and valve can be replaced with a frozen allograft (cadaver or homograft) aortic root, a porcine xenograft aortic root, or a Dacron tube graft with a pericardial or porcine bioprosthesis inserted in it. A Ross-Shumway procedure is contraindicated because of the aneurysmal disease and underlying connective tissue disorder. The durability of all these various tissue valve alternatives, however, is limited. Furthermore, the risk at reoperation is not negligible; for example, an allograft may be densely calcified, sternal re-entry may be perilous, the coronary ostia need to be reimplanted again, and the aortic annulus may have scarred down excessively.

Conversely, aortic valve-sparing techniques with avoidance of postoperative anticoagulation are highly appealing for younger Marfan patients who may anticipate further major surgery on the down stream aorta or skeleton or who wish to become pregnant.

These operations can be subdivided into the aortic root “remodeling” procedure of Yacoub (which has been used since 1979) and the aortic root “reimplantation” procedure, popularized by Tirone David since 1988. The easiest way to distinguish between them is whether the procedure employs 2 aortic suture lines (Yacoub remodeling technique) or 3 (David reimplantation technique), however they all rely on sewing the scalloped graft to residual aortic sinus tissue around the aortic cusps and commissures proximally.

One putative advantage inherent in the Yacoub remodeling approach is that the Dacron graft billows slightly, thereby mimicking the natural sinuses of Valsalva. This allows more natural leaflet motion, and should theoretically reduce cusp closing stresses and thereby enhance long-term leaflet durability; drawbacks include absence of fixation of the aortic annulus (more properly termed the “ventriculo-aortic junction”, which is coronet shaped) and more exposed suture lines which can predispose to bleeding.

Nishant D. Patel et al, in their study has began using De Paulis Valsava graft since May 2002 in hope that the Valsava graft would stabilize the annulus and preserve sinuses, minimizing leaflet stress and maintaining natural opening and closing characteristics.

In the past David used two remodeling techniques which other authors called them “T. David-II” (classic Yacoub remodeling) and the “T. David-III” (remodeling with an external synthetic

strip added between the left and right mitral fibrous trigones [the fibrous portion of the left ventricular outflow tract] as an external annuloplasty. The rationale behind of various modifications is that; all reimplantation methods firmly anchor the aortic graft at the ventriculo-aortic junction, but the valve is surrounded by the tubular Dacron graft.

D.Craig Miller et al resorted to numbering David's valve-sparing aortic root operations because Tirone's technique changes frequently. A "T.David-I" is his original reimplantation procedure using a cylindrical tube graft; and "T.David-II" and "T.David-III" are variations of Yacoub's remodeling procedure; a "T.David-IV" is reimplantation using a 4-mm larger graft size with plication circumferentially at the sinotubular junction above the tops of the commissures; and a "T.David-V" (used by David and D.Craig et al since May 2001) is reimplantation using an even larger graft size (d+6-8mm) which is "necked-down" at the both the bottom and the top ends to create graft pseudosinuses. However, F.Settepani et al, recently reports have suggested higher incidence of late AI compared with the reimplantation technique, most likely secondary to the lack of annular fixation. The higher incidence of late AI in the remodelling group has convinced most surgeons to choose the reimplantation technique as the preferred technique. However, the major criticism of the standard reimplantation technique has been the absence of sinuses of Valsava.

Cochran procedure and the use of various types of modified Dacron grafts, all of which are designed to create aortic pseudo-sinuses in the graft. Modifying fabrication of the Dacron graft used as the scaffold for preserving the valve seems attractive, as many patients - including those with the MFS and even others with fairly normally-functioning bicuspid valves - wanted to avoid indefinite anticoagulation, if possible but caution is necessary. One U.S. center is reporting at the 2001 AHA Scientific Sessions a 16% reoperation rate within only 1-2 years after operation. However, the overall (MFS and non-MFS) survival and reoperation-free results 10 years after a Yacoub procedure are satisfactory (if one excludes those with acute aortic dissection), many have residual or recurrent AR.

Such adverse consequences are probably related to progressive aortic annular dilatation.

Conversely, the 10 year results after the original valve reimplantation methods pioneered by Tirone David et al. still appear to be excellent, despite the theoretical drawback that no pseudo-sinuses exist. Major European centers with special expertise and experience in thoracic aortic surgery have not wavered from the original T. David reimplantation concept. Given David's personal results out to 5-10 years in 120 patients (64 underwent a T. David-I reimplantation procedure, and 56 had a Yacoub-type remodeling procedure [termed T. David-II or T. David-III]; 48 had the MFS), he cannot conclude conclusively whether one or the other is more durable; however, he has switched back to a reimplantation technique the ("T. David-V" technique using a 2-4mm larger than calculated graft size which is pleated at the annulus and at the neo-sino tubular junction) because it is more hemostatic (12% vs. 6% incidence of surgical take-back for bleeding), the aortic annulus is firmly fixed and cannot dilate in the future, and no abnormal pathological tissue remains behind. This author (on the basis of a personal experience of valve-sparing aortic replacement cases going back to 1993, over one-half of which had MFS) agrees with David's changing preference, especially for patient with the MFS. There has been only one late valve failure in the reimplantation group (who required reoperation 7 years later); conversely, several patients who have had a Yacoub-type remodeling procedure have some residual AR which appears to be progressive over time, and one young man is scheduled for reoperation. Many cardiac surgeons switched temporarily to favor the Yacoub technique since it is quicker, saves one suture line, and requires much less extensive dissection and mobilization of the base of the aortic root, but some recognized that it was not as good -- nor durable -- an operation as valve reimplantation. Recently, David and colleagues reported 8-year freedom from

moderate-to-severe AI of 90% ± 6% with the reimplantation technique. A modification involving the creation of neo-sinuses was implemented during the last three years of the David group's experience. In smaller series from the same center consisting of Marfan syndrome patients exclusively, De Oliveira et al, reported a 10-year freedom from reoperation of 100%. However, the actual freedom from AI exceeding 2+ was 71%± 13% at 10 years.

Finally, seasoned surgical judgment and exceptionally careful patient selections are paramount when it comes to whether or not valve-sparing aortic root replacement is the best alternative for each individual patient. In this patient, the indications for replacement of the affected aortic segment were based on that following criterion: family history of Marfan syndrome, two siblings having died due to the same problem, normal aortic valve function and the aortic sinus diameter 46mm, however is recommended that, when the aortic sinuses reaches 50mm in patients with Marfan syndrome and 55mm in others.

### Acknowledgement

Prof Zhang Kai Lun (Consultant Cardiovascular surgeon), Prof Jiang Xiong Gang, Dr. Sun Tucheng

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