

Tyrone David aortic valve sparing operations: Mid term Durability

Authors:

Amr Rouchdy: Assistant Professor of Cardiothoracic surgery, Cairo University .

Alaa Farouk: Assistant Professor of Cardiothoracic surgery, Cairo University.

Corresponding Author:

Amr Rouchdy

Address: 89, moustafa el nahas st , Nasr city, Cairo

Tel: 0100/5441623

E-mail: amrrush@hotmail.com

Abstract

Objectives we investigated the durability of Trone David for ascending aortic aneurysms at midterm.

Methods From September 2005 to September 2010 ,53 patients underwent Tyrone David Aortic valve sparing operation for ascending aortic aneurysm and aortic regurge. Clinical examination, transthoracic echocardiography and CT scan were done annually along with a phone interview every 6 month to detect aortic valve related adverse events

Results The mean follow up for survivals was 84.5 ± 21.2 months. The operative mortality (30 days) was 7.54% (4/53). All patients left the hospital after an echocardiography done revealing less than mild AR. During follow up, 10 patients developed mild AR, 4 patients developed moderate AR(at 8,14,23and 57 months respectively) , and 1 patient developed severe AR. The freedom from reoperation at 9 years was 97.6% among survivals.

Conclusion Aortic root valve sparing operation showed integral structural and functional durability at midterm.

Introduction

Valve sparing operations were popularized over the last three decades¹. The freedom from prosthetic valve related adverse events represented the goal for this trend². Reimplantation of aortic root showed superior results than remodeling for the freedom from residual and progressive aortic regurgitation^{3,4,5}.

Although the reimplantation of the aortic root inside a tube graft offered a reasonable solution for limiting a progressive annular enlargement and consequent structural and functional aortic valve failure, necessitating reoperation^{6,7}. Yet the results in patients who had a connective tissue disorder as Marfan syndrome and bicuspid aortic valve disease are controversial^{8,9}.

In this study we prospectively studied the mid-term aortic valve structural and functional deterioration, survival and risk or reoperation.

Patients and Methods

From September 2005 to September 2010, 53 patients underwent Tyrone David valve-sparing aortic root replacement at Cairo University hospitals. All patients had ascending aortic aneurysm and aortic regurgitation (AR). Patients with acute dissection, connective tissue disorders (Marfan), bicuspid aortic valve (BAV) and Patients with severe annuloaortic ectasia (aortic annulus ≥ 27 mm) were excluded from this study. Patients with chronic ascending aortic dissection were included.

Operative procedure

Aortic arch arterial cannulation was done in 19 patients (35.9%) where the arch was free of significant disease. Femoro-atrial (37.7%) or axillary-atrial cannulation (7.5%) was done in the rest of patients. 8 patients (15%) had an aortic arch involvement. In the latter situation, open clamp technique and circulatory arrest with retrograde cerebral perfusion was applied. Also systemic hypothermia to 25°C was done prior to circulatory arrest.

Reimplantation was done via excision of the diseased sinuses except for 5-8 millimeters, and detaching coronary artery buttons. The left ventricular outflow tract was dissected circumferentially to a level just below the aortic annulus. Then, placing the aortic cusps, annulus and sub-commissural triangles inside a straight tubular Dacron graft. Selection of the size of the graft depends on measuring the size of the aortic annulus with a standard valve sizer, and adding 7mm to it.

Haemostatic closure was secured with two suture lines. One by horizontal interrupted 2/0 braided polyester sutures enforced with Teflon pledgets, through the left ventricular outflow tract underneath the insertion of aortic cusps and tied on the outside. The second is done with a scalloped continuous 4/0 polypropylene sutures to align the base of the sinuses with the graft.

The three commissures are suspended inside the graft and secured with pledgeted 3/0 polypropylene suture. Neo-aortic sinuses were created by plicating the graft with 5/0 polypropylene suture at the level of the commissures. The left and right coronary buttons were re-implanted as full thickness Carrel buttons using 5/0 polypropylene running suture enforced with native pericardium.

The cooptation level of the cusps was carefully inspected. Distal anastomoses were done with 3/0 polypropylene running suture enforced with native pericardium.

Follow up

Clinical examination, transthoracic echocardiography and CT scan were done annually along with a phone interview every 6 month to detect aortic valve related adverse events.

Statistical analysis

Continuous variables are expressed as the mean \pm standard deviation. Categorical data were tabulated in 2^xn tables. Microsoft Excel was used for descriptive and analytical statistics.

Results

Patients' preoperative characteristics are described in Table (1). Patients were followed up for a maximum of 9 years. The mean follow up for survivals was 84.5 \pm 21.2 months. Three patients were lost for follow up at 3 years, and additional 2 at 6 years from the date of their operation. The total number of patients who completed the study was 42(79.24%)

Survival

The operative mortality (30 days) was 7.54% (4/53). Two patients died due to delayed recovery and consequent complications of prolonged mechanical ventilation and multiorgan failure. One patient died due to infective endocarditis that led to aortic root abscess, disruption of sutures and bleeding. Under coverage of antibiotics, a Bentall operation was done 20 days later, but there was a failure to wean off bypass. One patient died due intractable haemorrhage. He was a 73 old patient with ascending and arch aneurysm and weak tissue that barely hold the sutures. He was closed over packs and reopened after 4 hours, and then continued to bleed despite all medical and surgical measures. Finally, he died after 48 hours.

During the follow up, two patients were found dead due to hepatitis C virus complications at 5 years and one died at 8 years due to disseminated cancer prostate

Aortic regurge

All patients left the hospital after an echocardiography done revealing less than mild AR. There was no need for reoperation during the hospital stay. During follow up, 10 patients developed mild AR, 4 patients developed moderate AR(at 8,14,23and 57 months respectively) , and 1 patient developed severe AR. The later patient was re-operated upon 30 month after the initial operation and the aortic valve was replaced by a mechanical valve. The freedom from reoperation at 9 years was 97.6% among survivals who completed the follow up.

Operative data

Most patients had a graft size 28. The Circulatory arrest was 24.7 ± 6.9 minutes in patients when had a concomitant aortic arch surgery. 4 patients had a concomitant coronary artery bypass. 3 patients had a vein graft to Obtuse marginal , right coronary artery(RCA) and to the left anterior descending. These arteries were found stenotic in a preoperative coronary ct angiography. One patient had a vein graft to RCA due to right ventricular impairment and failure to wean of bypass. Operative data were listed in Table (2).

Table1: Preoperative patient characteristics

| Charactaristic | |
|--------------------------------|------------------|
| Age(years) | $57.6\pm 11.2^*$ |
| Male gander | 37/53(69.8%) |
| Hypertension | 39/53(73.6%) |
| Diabetes | 14/53(26.4%) |
| COPD | 11/53(20.7%) |
| Ejection Fraction % | $57.4\pm 9.3^*$ |
| Ascending aortic diameter (cm) | $6.6\pm 1.2^*$ |
| Aortic Annulus (cm) | $2.41\pm 0.13^*$ |
| Mild AR | 2/53(3.77%) |
| Moderate AR | 19/53(35.85%) |
| Severe AR | 32/53(60.37%) |

* data were expressed as mean \pm SD. COPD=Chronic obstructive pulmonary disease ,AR=aortic regurge

Table 2: Operative data

| | |
|---------------------|-------------|
| Graft size 26 | 3(5.5%) |
| Graft size 28 | 37(52.8%) |
| Graft size 30 | 12(22.6%) |
| Graft size 32 | 1(1.9%) |
| Ischemic time (min) | 165.6±29.9* |
| Bypass time(min) | 203.6±32.3* |

* data were expressed as mean±SD

Discussion

Aortic valve replacement has been the standard of care operation for aortic regurgitation for many years. Advances in operative procedures and improved knowledge regarding the mechanism of AR contributed to the increased interest of repair techniques¹⁰. Type 1b AR patients caused by dilatation of sinotubular junction and aortic annulus were the target for aortic valve sparing procedures¹¹. The loss of dynamic distensibility of aortic root¹², associated with reimplantation aortic valve sparing procedures, raised concerns about the durability of such technique¹³.

Complex aortic valve pathologies were abandoned in this study. Repair of regurgitated bicuspid aortic valve is quite complex and associated with lesser 10 year freedom from reoperation¹⁴. Inferior results were found in Marfan patients undergoing valve sparing procedures, although the superiority of Tyrone David procedure over Yacoub technique in those patients¹⁵. Both Marfan and bicuspid aortic valve are associated with dilated aortic annulus and even if reasonable, it will dilate later⁹.

Proper graft sizing and adjustment of the height of the commissures are the keys for durable valve repair. Failure to adjust will lead to leaflet prolapse and subsequent AR¹⁶. Proper leaflet coaptation was ensured before the sutures lifting the commissures were tightened.

Tyrone David reported an overall freedom from reoperation in the aortic valve at 10,15, and 20 years as 97.1%, 94.2%, and 94.2% respectively. He found that age by increments of 5 years was the only predictor for mortality⁶. Shrestha and colleagues reported in a study with a mean follow up of 10±2 years that the freedom from reoperation was 96%,91%, and 87% at 1, 5 and 10 years¹⁷.

AS Tyrone David procures are quite complex and learning curve related results are obvious. Patients developed moderate AR at 8 and 14 months were done in the early phase of this series . Too narrow or too wide graft size was probably the cause. Although apparently proper coaptation was achieved at the time of surgery, but this was not enough for a longer duration. Aortic valve cusps must coapt above the level of the nadir of the aortic annulus and the coaptation length must be of at least 4mm in the central part¹⁶. The main cause of late aortic valve regurgitation is indefinite, some explained it by degeneration of aortic cusps and others proposed that this process was accelerated by rigid prosthetic aortic root¹⁸.

Conclusion

The results of Tyrone David valve sparing aortic root replacement are acceptable in the mid- term for carefully chosen patients, regarding patient survival and valve durability.

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