Incidence and progression of mild aortic regurgitation after Tirone David reimplantation valve-sparing aortic root replacement

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Objective: The study objective was to determine whether recurrent or residual mild aortic regurgitation, which occurs after valve-sparing aortic root replacement, progresses over time.

Methods: Between 2003 and 2008, 154 patients underwent Tirone David-V valve-sparing aortic root replacement; 96 patients (62%) had both 1-year (median, 12 ± 4 months) and mid-term (62 ± 22 months) transthoracic echocardiograms available for analysis. Age of patients averaged 38 ± 13 years, 71% were male, 31% had a bicuspid aortic valve, 41% had Marfan syndrome, and 51% underwent aortic valve repair, predominantly cusp free margin shortening.

Results: Forty-one patients (43%) had mild aortic regurgitation on 1-year echocardiogram. In 85% of patients (n = 35), mild aortic regurgitation remained stable on the most recent echocardiogram (median, 57 ± 20 months); progression to moderate aortic regurgitation occurred in 5 patients (12%) at a median of 28 ± 18 months and remained stable thereafter; severe aortic regurgitation developed in 1 patient, eventually requiring reoperation. Five patients (5%) had moderate aortic regurgitation at 1 year, which did not progress subsequently. Two patients (2%) had more than moderate aortic regurgitation at 1 year, and both ultimately required reoperation.

Conclusions: Although mild aortic regurgitation occurs frequently after valve-sparing aortic root replacement, it is unlikely to progress over the next 5 years and should not be interpreted as failure of the valve-preservation concept. Further, we suggest that mild aortic regurgitation should not be considered nonstructural valve dysfunction, as the 2008 valve reporting guidelines would indicate. We need 10- to 15-year follow-up to learn the long-term clinical consequences of mild aortic regurgitation early after valve-sparing aortic root replacement. (J Thorac Cardiovasc Surg 2014;147:169-78)

ACD

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In patients with aortic root pathology and good aortic valve cusp integrity, valve-sparing aortic root replacement (V-SARR) offers an attractive alternative to a conventional composite valve graft (CVG) with a mechanical or bioprosthetic valve. Valve-sparing procedures alleviate the need for anticoagulation with mechanical valves and minimize the risk of early structural valve deterioration in young patients receiving bioprosthetic valves. Although these factors make V-SARR appealing, a key question in deciding the best operative strategy is the expected durability of the repair and identifying which patients are at higher risk for failure. One of the risk factors predictive of V-SARR failure is postoperative aortic regurgitation (AR), which can progress and require reoperation.[1-4] Previous reports have focused on postoperative AR and reoperation; however, whether mild AR early after V-SARR progresses has not been completely assessed. In an elegant study from Hans Sievers' group in Lübeck, Germany, by Hanke and colleagues,[1] progression of AR was analyzed after 2 types of V-SARR: Yacoub remodeling (n = 108) and Tirone David reimplantation (n = 83). After a median follow-up of 2.3 years, factors associated with progression of AR included Marfan syndrome (MFS), aortic valve repair (central plication with pericardial pledgets), and preoperative annular diameter.[1] The present study sought to expand on those results over a longer period of time in patients who underwent a Tirone David-V Stanford modification V-SARR procedure.

MATERIALS AND METHODS

Study Cohort

From 2003 to 2008, 154 patients underwent Tirone David-V Stanford modification V-SARR; 96 patients (62%) had both a 1-year follow-up transthoracic echocardiogram (TTE) (median, 12 ± 4 months after V-SARR; interquartile range [IQR], 9-14 months) and a recent, mid-term TTE (median,

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Abbreviations and Acronyms

AI = aortic insufficiency
AR = aortic regurgitation
BAV = bicuspid aortic valve
CTD = connective tissue disorder
CVG = composite valve graft
IQR = interquartile range
MFS = Marfan syndrome
TAV = trileaflet aortic valve
TTE = transthoracic echocardiogram
V-SARR = valve-sparing aortic root replacement

62 ± 22 months after V-SARR; IQR, 44-82 months) and constituted the study cohort. For patients with AR progression beyond 1 year, which was defined as an increase in 1 or more AR grades, intervening TTEs were graded to determine when the valve deteriorated. Clinical follow-up for all 96 patients ranged from 1.8 to 9.2 years (mean, 5.3 ± 1.8 years; median, 5.2 ± 1.8; IQR, 3.7-6.8 years), totaled 487 patient-years, and was 100% complete.

All TTE images were evaluated by a single American Society of Echocardiography Level III trained echocardiographer (D. H. L.); degree of AR was graded semiquantitatively on a scale from 0 to 4+ based on jet width according to standard criteria.[5] Quantitative methods, such as quantitative Doppler and effective regurgitant orifice, could not be used because of the disparate sources of echocardiography images and eccentric AR jets. Where possible, AR grade of moderate or more was corroborated by reversal of flow in the distal arch or descending aorta.

For comparison purposes, the total cohort was divided into 2 subgroups: those with and those without mild AR on the 1-year TTE. Subset analysis was then performed on the patients with early mild AR that subsequently worsened. Because of early failure associated with the use of neo-suspensory chords in patients with a bicuspid aortic valve (BAV),[6,7] an additional set of analyses was performed excluding the 2 patients with neo-suspensory chords.

Operative Procedure

The Stanford modification of the Tirone David-V V-SARR procedure has been described.[8] Depending on the extent of the aneurysm, total or partial arch replacement using the "Peninsula technique" in patients with a BAV was performed as described previously.[9]

Statistical Analysis

The preoperative and intraoperative characteristics listed in Tables 1 and 2 were compared between groups using chi-square tests for nominal and ordinal variables, and general linear model multivariate analysis for scalar variables. Factors found to have a P value less than .25 on multivariate analysis for predicting AR progression were assessed using log-rank (Mantel–Cox) analysis and nonparametric Kaplan–Meier actuarial curves. Cox proportional-hazard regression analysis was attempted, but the model was unstable because of an inadequate number of adverse events. All statistical testing was performed using commercially available software (SPSS Statistics 21; SPSS, IBM, New York, NY). Data are reported as median or mean ±1 standard deviation; IQR are included when appropriate. The Stanford institutional review board approved the study, and informed consent was obtained from the patients at time of contact.

RESULTS

Preoperative and Intraoperative Characteristics

The average age of the total cohort (n = 96) was 38 ± 13 years (IQR, 27-48 years), 71% were male, 31% had a BAV, and 41% had MFS. Patients with a BAV were further subdivided using the classification system by Sievers and Schmidtke,[10] with the majority being Sievers' 1/L-R[10] (Table 1).

There were no statistically significant differences between the subgroups with or without early mild AR in terms of age, incidence of connective tissue disorder (CTD), incidence of BAV, or preoperative AR grade. There were significantly more male patients in the subgroup without early mild AR compared with the subgroup with early mild AR (P = .012), and this subgroup was correspondingly taller (P = .044). Arch replacement was performed in 30 patients (31%, Table 2), and aortic valve repair was performed in 49 patients (51%, free margin shortening in all except 2 patients, raphé resection in 5 patients with BAV, and neo-suspensory chord creation in 2 patients with BAV). Preoperative and postoperative annular diameters, as well as magnitude of annular diameter change, were not significantly different between the subgroups, nor was the need for concomitant aortic valve repair. Mild AR on predischarge TTE was evident in 17% of patients in the subgroup with mild AR on 1-year TTE, which was significantly higher than in the subgroup with no AR on 1-year TTE (0%, P = .003). Timing of the 1-year TTE was not different between subgroups; however, the time interval between V-SARR and the most recent mid-term TTE was significantly longer in the subgroup without early mild AR (74 ± 21 months vs 53 ± 20 months, P = .008, Table 3).

Incidence and Progression of Postoperative Aortic Regurgitation

Forty-one patients (43%, Figure 1) had mild AR on the 1-year TTE; of this subgroup, 35 patients (85%) continued to have mild AR on most recent TTE (median, 57 ± 20 months; IQR, 40-73 months) and were included in the "mild stable AR" subset. The mild AR in 5 patients (12%) progressed to moderate AR at a median of 28 ± 18 months (IQR, 27-38 months), which remained stable thereafter (median follow-up, 44 ± 27 months; IQR, 38-49 months). These 5 patients plus 1 patient with AR that progressed to severe AR requiring reoperation were included in the "progression of mild AR" subset for comparison purposes. Among the patients in the "progression of mild AR" subset, AR grade increased at a median of 28 ± 17 months (IQR, 22-36 months) postoperatively. Of note, only 1 patient (2%) with mild AR on 1-year TTE had progression to greater than moderate AR over the 53-month follow-up period.

Five patients (5%) had moderate AR on the 1-year TTE, but the degree of AR did not progress subsequently over a median follow-up of 49 ± 28 months (IQR, 46-95 months). Four of these patients initially had mild AR, and 1 patient had no AR on the predischarge TTE. Two patients (2%) had more than moderate AR on the 1-year TTE (both ultimately