Standardization of the aortic valve sparing procedure allows introduction of a new surgical technique with good early results: Retrospective analysis

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DOI: 10.33963/v.phj.99370

Received:
October 5, 2023

Accepted:
February 11, 2024

Early publication date:
February 16, 2024

INTRODUCTION

Valve sparing aortic root replacement (VSARR) is a group of techniques developed over 30 years ago, which allows for replacement of a dilated aorta with a vascular graft and preservation of the native aortic valve. They are divided into two subgroups in accordance with the main principles of VSARR— aortic valve reimplantation and aortic root remodeling.

In the 2014 European Society of Cardiology guidelines on the diagnosis and the treatment of aortic diseases, VSARR is recommended in young patients with aortic root dilatation and tricuspid aortic valve as the treatment of choice [1].

VSARR techniques are assumed to require long training and great surgical experience because, in the early years after introduction, the effect was assessed visually by the performing surgeon and was, therefore, subjective. We present a case series of aortic root remodeling with external aortic annuloplasty as a newly introduced technique. We used an advanced standardization of the technique with several intraoperative measurements, which allowed us to perform the procedure with predictable early results after short training.

METHODS

We present 37 consecutive cases of aortic root remodeling with external aortic annuloplasty performed from 27/09/2016 to 14/01/2020. These operations were carried out predominantly (75.7%) by one surgeon who had no experience in valve-sparing aortic root replacement, however, with vast experience in Bentall procedures. We compared the early results with the group of 41 patients operated on from 02/07/2012 to 04/12/2019 with the use of the reimplantation technique. The group was assembled retrospectively. The patients were also consecutive cases, but the time frame was wider to include a similar number of cases. The aortic valve reimplantation procedures were performed by 5 surgeons with many years of experience with that technique.

The inclusion criterion was aortic root aneurysm with competent or regurgitant aortic valve.

Before March 2019, the surgeries were performed in the Department of Cardiac Surgery and Transplantology, The Cardinal Stefan Wyszynski Institute of Cardiology, Warsaw and then in the Department of Cardiac Surgery, the Medical University of Bialystok.

Data were collected and analyzed retrospectively. The study was approved by the ethics committee of the Medical University of Bialystok.

In our series, aortic root remodeling with external aortic annuloplasty was performed. This is a highly standardized method using specific tools and measurements. The procedure has been described in detail by Lansac et al. [2]. The main points of standardization are graft sizing and assessment of the achieved aortic cusps coaptation. We used the designed caliper described by Schäfers [3] to evaluate any resident or induced prolapse of the aortic cusps (Supplementary material, *Figure S1*). It is a purpose-designed surgical tool that allows measurement of the effective height of native aortic cusps, and, due to its caliper-like function, it helps to correct them to the requested value. The use of the effective height measure-

ment changed the possibilities for predicting the effect of the treatment [4]. Central plication of the free leaflet margin was made until the effective height of 9 mm was obtained.

We collected demographic, clinical, and echocardiographic data (all patients had the preoperative and postoperative echocardiographic examination) and compared the early results with the group of patients operated on using the reimplantation procedure without such specific measurements and assessed based on experience. We sought to demonstrate that standardization is the key to success and allows introduction of the new method faster, even after short training. The learning curves have been drawn.

Statistical analysis

In the statistical analysis, due to the small number of observations, non-parametric methods were used. The comparison of the groups in terms of qualitative features was carried out using Fisher's exact test, and in terms of ordinal and quantitative features, using the Mann–Whitney test. Data were reported as medians (interquartile ranges) for continuous variables and as absolute numbers and percentages for categorical variables. Statistical calculations were performed using IBM SPSS Statistics version 20.0. A *P*-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

No statistical significance was found between both groups regarding the initial status of operated patients.

There were no statistically significant differences in terms of cardiopulmonary bypass time (CPBT) or aortic cross-clamping time (CCT) in either group.

The most important parameter for evaluating the outcome of aortic valve-sparing procedures is the degree of postoperative aortic regurgitation. In our series, 91.9% of patients had a completely competent valve or mild, insignificant regurgitation after surgery. In the reimplantation group, this percentage was 90.2%. The differences were not statistically significant (Supplementary material, *Figure S2*).

In the remodeling group, smaller vascular prostheses were implanted than in the reimplantation group. The median size of the prosthesis used for the remodeling was 28 mm, while for the reimplantation it was 30 mm. The diameter of the graft used for remodeling or reimplantation was related to the degree of reduction of the aortic annulus. There was no significant difference in aortic valve gradients between groups though and the obtained transvalvular gradients had no hemodynamic significance.

No operative or in-hospital death occurred during observation time in either group.

The full characteristics and results of both groups are summarized in Table 1.

The final result of the surgery was evaluated by transthoracic echocardiographic examination on discharge. The postoperative function of the aortic valve was similar in both groups.

Lansac et al. [5] in their article reviewed the results of transthoracic echocardiography on their patients' discharge from the hospital. An acceptable result — maximum mild aortic regurgitation — was present in 99.4% of those patients. Early results of aortic valve reimplantation were described by Shrestha et al. [6] — there was no regurgitation or mild regurgitation on discharge from the hospital in 94.4% of cases. David et al. [7] presented patient evaluation one year after the operation. The proportion of patients with maximum mild aortic valve deficiency was 94.8%.

The success of the introduction of the new method would be limited in cases of prolonged surgery duration. CPBT and CCT were analyzed and did not show statistically significant differences. The mean CPBT in our series was approximately 190 minutes with the CCT about 158 minutes, while in the reimplantation group, those values were 199 and 163 minutes, respectively. Klotz et al. [8] obtained confirming results. In the group of patients undergoing reimplantation procedure, the CPBT was on average 218 minutes with 180 minutes CCT, while for the remodeling group 177 and 134 minutes, respectively. This was also confirmed in an article presenting the largest material published so far from a single center in Poland. Gocoł et al. [9] compared the late results of VSARR procedures. The CPBT was on average 156 minutes for reimplantation and 123 minutes for remodeling, with CCT 133.5 and 103 minutes, respectively. Differences can be reversed in favor of reimplantation in multicenter observations. David's team presented the material in which these values were 142 and 118 minutes, respectively [7], while De Paulis achieved a result of 128 and 108 minutes [10]. Lansac et al. [5], who had performed a procedure analogous to that used in Group I, presented results with average clamping times of approximately 145 minutes. It appears that the operator's experience, rather than the type of procedure, is more important in reducing the surgery time. This is a very important clinical issue because it has been shown that if CPBT and CCT exceed 240 minutes and 150 minutes, respectively, we can observe a significant increase in 30-day mortality [11]. The learning curves for CCT and CPBT are presented in the Supplementary material, *Figures S3* and *S4*.

There are some limitations to this analysis. The presented series was compared retrospectively, and the numbers in both groups were small. The procedures in the control group were performed by different surgeons. Since VSARR is still not as popular as we would like and it is quite difficult to gather a sufficiently large group of participants, we had to include all consecutive patients operated on by different surgeons. Moreover, we assessed only early results.

The analysis of our material allows us to conclude that the use of intraoperative measurements of the aortic complex allows for performing a successful aortic valve sparing procedure even after short training limited to one wet lab workshop.

Table 1. Characteristics of groups

	Remodeling	Reimplantation	*P*-value
Age, years	51 (39.5–61.5)	46 (32–58.5)	0.10
Male	29 (78.4%)	32 (78%)	1.00
Symptoms (≥NYHA II)	22 (59.5%)	14 (35.0%)	0.04
Marfan syndrome	3 (8.1%)	10 (24.4%)	0.07
BAV	8 (21.6%)	10 (24.4%)	0.80
Associated procedure	3 (8.1%)	8 (19.5%)	0.20
Urgent surgery	2 (5.4%)	2 (4.9%)	1.00
Aortic diameter, mm	55 (50.5–59)	53 (50–56)	0.17
EF, %	60 (56.3–65)	60 (55–65)	0.76
LVEDD, mm	57 (54–60)	56 (52–59.5)	0.31
LVESD, mm	37 (34–43)	39 (31–43)	0.78
AR none (preoperative)	0 (0%)	5 (12.5%)	0.06
AR mild (preoperative)	9 (24.3%)	15 (37.5%)	0.23
AR moderate (preoperative)	18 (48.6%)	12 (30.0%)	0.11
AR severe (preoperative)	10 (27.0%)	8 (20.0%)	0.59
CPBT, min.	185 (158.5–213.5)	185 (163.5–225.5)	0.39
CCT, min.	158 (134–173)	151 (138–183)	0.56
Graft size, mm	28 (28–29)	30 (28–30)	0.0004
AR none (postoperative)	21 (56.8%)	21 (51.2%)	0.64
AR mild (postoperative)	13 (35.1%)	16 (39.0%)	
AR moderate (postoperative)	2 (5.4%)	4 (9.8%)	
AR severe (postoperative)	1 (2.7%)	0 (0.0%)	
Reoperation (bleeding)	5 (13.9%)	6 (14.6%)	1.00
CRRT	1 (2.7%)	1 (2.4%)	1.00
Stroke	2 (5.4%)	0 (0.0%)	0.22
Sternal dehiscence	2 (5.4%)	1 (2.4%)	0.60
Paroxysmal atrial fibrillation	10 (27%)	3 (7.3%)	0.03

The data are presented as n (%) or medians (Q1–Q3)

Abbreviations: AR, aortic regurgitation; BAV, bicuspid aortic valve; EF, ejection fraction; LVEDD, left ventricle end-diastolic diameter; LVESD, left ventricle end-systolic diameter; NYHA, New York Heart Association; CPBT, cardiopulmonary bypass time; CCT, cross-clamp time; CRRT, continuous renal replacement therapy

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/polish_heart_journal.

Article information

Conflict of interest: None declared.

Funding: None.

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