

TOTAL AUTOLOGOUS RECONSTRUCTION OF THE AORTIC VALVE: CURRENT STATUS REVIEW

Vahe Chris Gasparyan

*MD, A. Prof. Chief of Cardiac Surgery Department, "Erebuni" Heart Center,
Medical Center "Erebuni", Yerevan, Armenia*

Introduction Aortic valve reconstruction has recently gained more attention as an alternative treatment for aortic valve disease. It is of special interest in patients who are young, those desiring pregnancy, those who live in remote areas with problems of poor drug compliance, and in cases where long-term anticoagulation is contraindicated.

Challenges Two main questions must be addressed when the use of this approach is being considered. The first is the need for a standard surgical technique that ensures a correct, reproducible, and safe result in terms of immediate competence and low trans-valvular gradients. The second is the long-term durability of the selected material.

Historical notes Total autologous reconstruction of aortic valve was first reported by Dr. Carlos Duran early in 1995 ("Aortic valve replacement with freehand autologous pericardium", *Journal Thoracic Cardiovascular Surgery* 1995; 110: 511-516). He used the plastic containers (molds) with three consecutive bulges of different sizes. These bulges reproduced the three valve leaflets with measures corresponding to the different aortic valve diameters. So, he tailored symmetric valves with three equal leaflets. Fifty-one patients with a mean age of 31.2 years underwent aortic valve replacement with glutaraldehyde-treated autologous pericardium. Pure aortic regurgitation was present in 28 (54.9%), stenosis in 9, and mixed disease in 14. Simultaneous mitral valve repair was done in 17 patients and replacement in 1. There were no hospital and two late deaths. Three patients required reoperation because of failure of the pericardial valve as a result of infective endocarditis in two (5 and 31 months after operation) and commissural tear at 8 months in another. One patient underwent reoperation at 24 months because of failure of the mitral valve repair. The pericardial aortic valve, which had 2+ regurgitation since the first operation, was also replaced. Macroscopic and microscopic examination findings in the excised pericardium were excellent. No thromboembolic events have been detected and no patient received anticoagulation therapy except one after mitral valve reoperation and replacement with a mechanical valve. The actuarial survival was $84.53\% \pm 12.29\%$ at 60 months, freedom from failure of the aortic reconstruction $83.83\% \pm 8.59\%$, and freedom from any event $72.59\% \pm 12.79\%$. Doppler echocardiographic study at most recent follow-up showed a mean gradient of 12.56 ± 8.10 mm Hg and mean regurgitation on a scale from 0 to 4+ of 0.80 ± 0.66 . Although the maximum follow-up was only 5 years, the results obtained encouraged to continue replacing the aortic valve with stentless autologous pericardium.

Dr Carlos Duran and his group reported very good long-term up to 16 years follow up results in 2005 (*European Journal Cardio-Thoracic surgery* 2005; 28: 200 – 205):

- The reconstructed aortic valve performed well with excellent hemodynamics;
- The mean follow-up interval was 10.5 ± 4 years, range 9–16 years with 4% late deaths and 7 patients lost to follow-up;
- Survival rate was $85 \pm 4\%$ and there were no episodes of thromboembolism;
- The freedom from reoperation was $72 \pm 6\%$ at 10 years and $45 \pm 8\%$ at 15 years;
- The freedom from structural valve degeneration (SVD) was $80 \pm 5\%$ at 10 years and $58 \pm 9\%$ at 15 years.

Dr. Shigeyuki Ozaki from Tokyo just recently reported his experience of more than 800 patients operated over the last 8 years. Dr. Ozaki used his own design molds of different sizes depending on the inter-commissural distance. So, he tailored an asymmetric valve with three separate leaflets of different sizes. (*Asian Cardiovascular and Thoracic Annals* October

2014; 22: 903-908). He reported very good mid-term results: 8-year overall survival rate was 85,4% and 8 year freedom from reoperation was 98,3% (Reported in 23rd Annual Meeting of the ASCVTS, Hong Kong, May 11 – 14, 2015).

Other surgeons from different countries (Dr. Domenico Mazittelli from Germany, Dr. Sampath Kumar from India) also perform this type of aortic valve reconstruction still using Dr. Ozaki's and Dr. Duran's design templates and molds.

So, the total autologous reconstruction of aortic valve is gaining more and more popularity all over the world. This operation provides a very acceptable mid-term and long-term results and I am sure the interest toward this operation will increase further. I have no doubt that this will become a GOLD STANDARD in Aortic Valve Surgery in the very near future. This is a stentless, autologous valve - a very good alternative for the prosthetic valves (especially mechanical) and Ross operation! Can be something better? NO. This is a real revolution in aortic valve surgery! The only problem is to have a simple, correct, reproducible and standard method for the intra-operative tailoring of the pericardial patch without need of any templates and molds.

Rationale I have invented a very simple, precise and reproducible method of determination of aortic valve parameters: each cusp free margin length (L left, L right, L non-coronary); cusps height (H); radius of the attached edge (R); and the commissural height (K). Using just a few very simple formulas we can determine the new valve parameters for intra-operative fashioning of the pericardium without any molds and templates (Journal Thorac Cardiovasc Surg 2000; 119: 386-387):

Each cusp free margin length (L):

L (left coronary) = $1,2 \times l$ (left coronary)

L (right coronary) = $1,2 \times l$ (right coronary)

L (non coronary) = $1,2 \times l$ (non coronary)

Cusps height: $H = 0,866 \times l$ (mean)

Radius of the attached edge: $R = 0,6 \times l$ (mean)

The commissural height: $K = 0,266 \times l$ (mean),

where l (left coronary) , l (right coronary) , l (non coronary) – are the corresponding inter-commissural distances, measured intra-operatively.

Indications This method of total autologous reconstruction of the aortic valve is especially important for young patients, childbearing age women and patients with small aortic root. It is a very good alternative for the valve replacement with a mechanical and biological prostheses. It will let a patient avoid a permanent anticoagulation therapy, producing a permanent risk of embolic events (stroke or peripheral) and/or hemorrhage. It is a feasible method resulting in good hemodynamics and a better quality of life, without anticoagulation. It is believed that being stentless and nonantigenic this tissue should perform at least better than the standard bioprosthesis.

Is it an "ideal" valve? The "ideal" valve should be: not rigid, allowing for the continuous movements of all heart structures; non-thrombogenic, requiring no permanent anticoagulation; hemodynamically sound, absent of significant trans-valvular gradients during exercise; durable, which presently means capable of more than 20 years of normal function; easily surgically implantable and economically affordable. Our valve does meet all these requirements!

Conclusion We have lost our way in aortic valve surgery! We have made a lot of valves but we have never followed in general the principals dictated by nature. There are only few surgeons in the world who pay attention to the very complex physiology of the aortic valve apparatus. As a result, we are trying to outperform nature! Wouldn't it be logical to conform to physiology? This has been formulated and pursued by only a few outstanding surgeons (Duran, David, Yacoub, Ross among others).