

Case Series

Aortic Root Enlargement by “Y” Technique – Our Experience

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Abstract

Aortic valve replacement is the commonest valvular surgery done around the world. In Asian population the aortic valve annulus size is smaller. So there is always a chance of patient prosthesis mismatch. There a number of techniques of aortic root enlargement during aortic valve replacement. We have used ‘Y incision technique’ in six of our patients in this case series. This technique is feasible and perioperative outcomes are promising. But it needs more mid and long - term results.

(Cardiovasc j 2024; 16(2): 98-101)

Introduction:

Aortic valve stenosis (AS) is the commonest valvular heart disease in the high-income countries requiring intervention in about 2.7 million peoples in Europe and 4.9 million peoples in North America.¹ Data from the lower socioeconomic countries are scarce. Indian studies comprising more than 17,000 patients showed that prevalence of isolated aortic stenosis was 4.8%-7.3%.^{2,3} Most definitive treatment of aortic valve stenosis is surgical aortic valve replacement or trans-catheter aortic valve replacement. Surgical treatment of the aortic valve, is the most preferred and performed treatment modality in our country, when replacement is mandatory. The reason is not always scientific but more often multifactorial like financial issues, life expectancy, availability of transcatheter valves, and operator experiences, etc. Moreover, surgeons in this region are more familiar with the surgical replacement than transcatheter replacement, although conditions are constantly changing.

However, Asian patients usually have significantly smaller aortic annulus in comparison to European patients,¹ which is a challenge during

the aortic valve replacement. An undersized valve replacement (replacing the native aortic valve with a smaller than required), due to a small annulus may cause patient prosthesis mismatch thus worsening the patient’s symptoms. To address this condition of narrow aortic annulus many traditional root enlargement procedures (Nick’s, Manouguian) are practiced. But Nick’s procedure is tricky, as it allows usually only one size increase of aortic annulus. And, in Manouguian procedure anterior mitral leaflet and left atrium has to be incised, putting the patient in a risk of developing mitral regurgitation.

Bo Yang, et all developed a novel technique of aortic root enlargement by which two to five size larger valve can be implanted at aortic position.⁴⁻⁶ This root enlargement technique essentially eliminates many issues related to small aortic prosthesis. However, very few surgeons have tried this technique in our country and very limited data are available from this subset of population. In this context, we have conducted a study in our patients, aiming to see the outcomes among the patients undergoing aortic valve replacement with aortic root enlargement using “Y” incision.

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Methods:

We have operated on six patients from January, 2023 to January 2024 by this technique. All the peri-operative data were collected and stored for statistical analysis.

Surgical technique:

We usually prefer to go on cardio-pulmonary bypass (CPB) with aortic and two stage venous cannulation. Transesophageal echocardiography (TEE) was used in every patient to assess the valve morphology, function, associated other valvular pathology, wall motion abnormality (RWMA), etc. For arresting heart, we used antegrade del-nido blood cardioplegia. After arresting heart, a partial transverse aortotomy was done 1.5 cm cranial to the sinotubular junction, up to left-non coronary commissure. The native aortic valve is excised off and the valve annulus was decalcified. The left and non-coronary commissure was incised from the aortotomy to aortomitral curtain close to left atrial dome. The incision was extended up to the nadirs of left (LCC) and non-coronary (NCC) cusps in a “Y” shaped fashion. A rectangular shaped Dacron patch (BARD® SAUVAGE® Filamentous Knitted Polyester Fabric) was prepared, a bit wider than the distance between the two nadirs of LCC and NCC. The patch was then sewn to the mitral annulus from left to right fibrous trigone with continuous 4-0 polypropylene sutures. The suture line was transitioned to the undermined aortic annulus at the nadir of LCC and NCC, sutured along the longitudinal length of the patch up to the transverse aortotomy incisions. The upsized valve sizer was placed in the neo-root touching all the nadirs and the sizer position were marked to place valve sutures. The sutures were placed in the patch and the prosthesis was placed with one strut facing left-right commissure, one strut close to right-non commissure, and the third one facing the patch. The sutures at the nadirs of left and non-coronary sinuses were tied first to prevent paravalvular leak. A portion of the patch remains below the replaced valve, in that way enlarging the aortic root and left ventricular outflow tract. The aortotomy was then closed from left to right, including the patch. TEE was done again to assess the valve functions, paravalvular leakage, any other neo-valvular pathology, neo-RWMA, air entrapment, etc. After satisfactory TEE report, we weaned each of the patients from

CPB and secured hemostasis after de-cannulation. We covered the aorta with the pericardium in all our cases. Patient was then shifted after routine chest closure keeping chest tubes, and pacing wire.

Results:

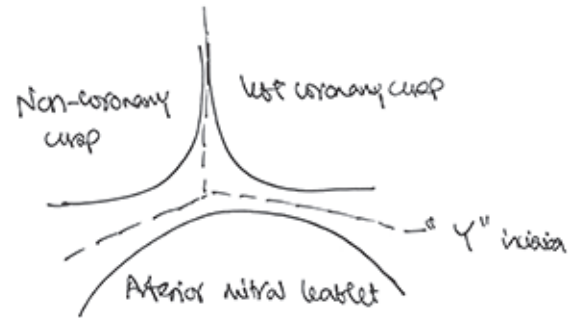


Figure 1: Schematic diagram showing “Y” incision (dotted lines)

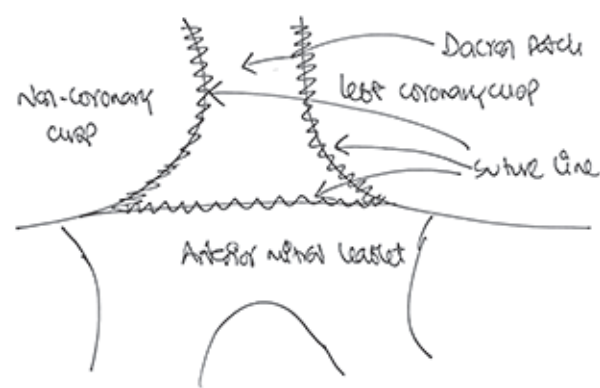


Figure 2: Schematic diagram showing sewing of the patch for “Y” root enlargement

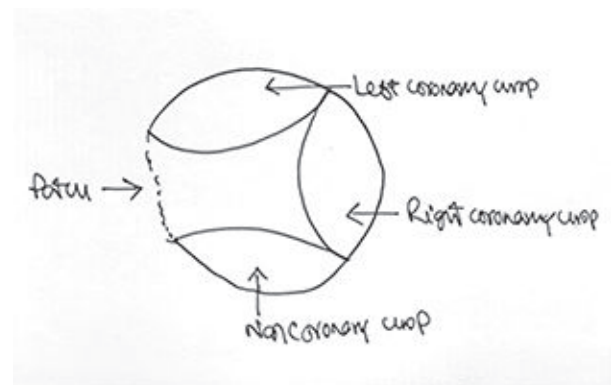


Figure 3: Schematic diagram showing the patch

Variables with results		Variables with results	
	Male Sex	5 (83%)	Operative time
Female Sex	1 (17%)	CPB time	182.8 ± 62.94
Mean Age	41 ± 20.1	“X” clamp time	110.8 ± 40.54
Mean Height (cm)	160.17 ± 7.2	ICU stays	1.8 ± 0.4
Mean Weight (kg)	59.3 ± 15.9	Hospital stays	
Mean BSA	1.61 ± 0.24	Valve size increased	1.4 ± 0.49
Mean LVEF %	51.25 ± 9.601	Stroke	-

We have operated on 6 patients with these techniques and 5 of them were male. Patients' age ranged from 68 to 15 years (mean 41 ± 20.1 years). Patients' body surface area ranged from 1.86 to 1.11 (mean BSA 1.61 ± 0.24). Mean cardiopulmonary bypass time was 182.8 ± 62.94 minutes (range 130-284 minutes), mean cross-clamp time was 110.8 ± 40.54 minutes (range 198-76 minutes). Up-sizing of the neo-implanted valve was 1.4 ± 0.49 than usual.

Discussion:

Bo Yang, et al first published their technique of aortic root enlargement in 2020, as they tried to mitigate the problems of patient prosthesis mismatch in small aortic root. Their concept was similar to Nick's or Manouguian, to enlarge the fibrous portion of root and thus the subsequent aortic annulus. The difference was that, the root was considerably enlarged, as the aortomitral curtain was entirely replaced without violating the left atrium or mitral valve.⁴ They showed that, sewing the patch to the aortic and mitral annulus is more secure when compared with other (Nick's and Manouguian) procedure where patch was sewed to aortomitral curtain. An “Y” incision instead of “T” incision was proposed to avoid unintended incision to the left atrium or the mitral valve in difficult adhesion cases. The proposed incision could be easily extended below the nadirs of aortic annulus without requiring dissecting out of aortic root. Concern was there, if the rectangular patch could distort the left coronary artery by pushing the left coronary sinus. However, the transverse sinus behind the patch allowed the patch or the left coronary artery to expand posteriorly without significant distortion of left coronary artery.⁵ In our series we haven't

experienced any case of coronary distortion or symptoms of coronary occlusion.

Later on, at 2021 they published another case report of a five times redo, finally treated with a mechanical valve and root enlargement of three valve sizes (native 21mm to 27mm valve) without distorting the LA or MV and no blood transfusion.⁵ And so on, they continued to publish, a 5-size increased valve replacement this time in multiple redo setup in a female patient. They even increased the ascending aortic diameter for future transcatheter valve replacement by a “roof” technique along with “Y” incision root enlargement. They reported of 48 cases by this technique and no mitral valvular disturbance or coronary distortion seen, so far.⁶ In all six of our cases, we found excellent aortic valve functions, no conduction defect and no mitral valvular issues. One thing of panic is that, during a double valve replacement, if one has replaced the mitral valve before root enlargement, or incase of a previously replaced normally functioning mitral valve, how they can enlarge the root by this technique? and, we think the Bedi technique may be a good solution for this query.⁷

Matsumoto et al.⁸ currently published of aortic root enlargement and valve replacement successfully by minimal invasive “Y” incision and roof technique. Their results are promising but long-term results are yet to be published. But they, so do we (from our experience of doing Mini-AVR), consider that this procedure is complex and exposure of aortic root is of paramount importance.

Ruben Osnabrugge et al.,⁹ in a meta-analysis showed on 19 European countries and North America, about 2,90,000 elderly patients with severe AS are transcatheter AVR (TAVR/TAVI) candidates and about 27000 patients annually

become eligible for TAVR. New technique known as “Roof” technique along with the “Y” incision root enlargement showing promising result for future TAVR platform in narrow aortic root, along with inadequate sino-tubular junction and narrow proximal ascending aorta.¹⁰

So far, we have operated on six patients (one tri-do included) with small aortic annulus with this technique. We have checked the valve function with trans-oesophageal echocardiogram after implanting. No valve malfunction or paravalvular leaks were observed. There were no bleeding issues from the suture lines. There was no hemodynamic instability or features of coronary obstructions observed. At follow-up till date all our patients are doing fine with improved exercise tolerance.

Conclusion:

The “Y” incision aortic root enlargement is simple and commendable. And, from our view point this approach solved many questions related to small aortic annulus and the short-term results are promising. Now, we can replace an aortic valve in a small aortic annulus with less worry. The mid- and the long-term results in a representable patient population are further required for a final comment. Surgeons may keep this technique in their arsenal, just in case they need to replace a larger aortic valve in a small annulus.

Acknowledgements:

The authors sincerely thank Prof. Mojibul Hoque, Senior Consultant and Co-Ordinator, Department of Cardiac Anesthesia for his huge contribution during surgery with the TEE and Dr. Mesbah Uddin, and Mr. Kamal Uddin for their support during surgery and data collection.

Conflict of Interest - None.

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