



AORTIC VALVE REPLACEMENT; RELATION OF AORTIC ANNULUS MEASURED BY ECHOCARDIOGRAPHY AND PROSTHESIS SIZE REQUIRED

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INTRODUCTION

Aortic stenosis is a common problem in old age, incidence is 2% in people having age more than 65 years, 3% in people age more than 75 years, and 4% percent over 85 year age have this disorder.¹ Aortic valve replacement surgery (AVR) is a preferred treatment in patients with severe Aortic Stenosis having symptoms of left ventricular (LV) dysfunction.² Echocardiography is an important tool to determine aortic stenosis, aortic regurgitation and severity of disease, aortic root annulus and LV function.^{3,4} The annulus can also be measured with the help of sizer that corresponds to the specific prosthesis per operatively. Accurate pre-operative measurement of aortic annulus (AoA) diameter is important as it helps in selection of appropriate sized prosthesis. Replacement of aortic valve with an appropriately-sized prosthesis is associated with smaller risk of

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ABSTRACT... Precise determination of the size of aortic annulus is very important for the preoperative evaluation before aortic valve replacement. **Objectives:** To determine the preoperative prosthesis size using echocardiography in patients undergoing aortic valve replacement. **Study Design:** Prospective observational study. **Setting:** Ch. Pervaiz Elahi Institute of Cardiology (CPEIC) Multan. **Period:** January 2013 to October 2014. **Methods:** (100 patients) Aortic annulus sizes were measured with TTE one week before surgery and with the help of sizer per-operatively. The data was analyzed by using SPSS V16. Quantitative variables were analyzed using mean and standard deviation and percentages were used for qualitative variables. Dependent sample t test was used to see accuracy of TTE in measuring aortic annulus size. **Results:** Out of hundred patients, 84(84%) were male. Mean age of the patients was 33.77 ±13.17 years. 51% patients underwent isolated Aortic valve replacement; redo-operations were done only in 4% patients. In 96% patient's mechanical prosthesis was used and in 4% patient's boiprosthesis was used for valve replacement. We found no significant difference in Aortic annulus measured pre-operatively with the TTE (23.54± 3.54) and measured per-operative with the sizer (23.96±3.36) with highly insignificant p-value 0.58. Aortic annulus size was almost same measured by these two techniques. **Conclusion:** Aortic annulus size measured with TTE helps to arrange the optimum size prosthesis before aortic valve replacement surgery.

Key words: Aortic annulus, Echocardiography, Prosthesis size, Aortic valve replacement, TTE (Treanstheoracic echocardiography).

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serious complications including damage to aortic root, paravalvular leakage, Atrio-ventricular block, or prosthesis embolization.⁵ If Aortic annulus size is measured pre-operatively, it will help to arrange appropriate sized valve prosthesis for the patient.

The purpose of this study is to find that either aortic annulus size measured pre-operatively with the help of TTE gives accurate estimation of prosthesis size being implanted during surgery or not. As Pre-operative echocardiographic annulus size measurement may prove helpful for choosing appropriate size of aortic valve prosthesis with narrow aortic annulus in patients with a large body-surface to avoid patient-prosthesis mismatch.

OBJECTIVE

To determine the preoperative prosthesis size using echocardiography in patients undergoing

aortic valve replacement.

METHODS

It was a prospective observational study, including 100 patients who were subjected to undergo aortic valve replacement with Aortic Valve disease (AR, AS, MAVD) at Cardiac Surgery Department, Ch. Pervaiz Elahi Institute of Cardiology (CPEIC) Multan. The duration of study was from January 2013 to October 2014. CPEIC is a Tertiary referral center for cardiac services in South Punjab. All patients undergoing isolated aortic valve replacement surgery or aortic valve replacement along with other procedures were included for the study. The personal identity of any patient was not disclosed to anyone. All patients' variables were entered prospectively in cardiac surgery database system of the hospital. After completion of study, the data was reviewed for age of presentation, sex, type, and size of prosthesis. In all patients transthoracic echocardiography was done about 1 week before surgery. The examination included 2-dimensional M-mode aortic. Standard left parasternal, right parasternal, suprasternal, subcostal, and apical views were obtained. Aortic annulus, aortic root, LV dimension and Ejection Fraction were measured. All operations were carried out through median sternotomy and standard cardiopulmonary bypass was established with cannulation in ascending aortic and two-stage single venous cannula.

Patient's body temperature was lowered to 28 °C to achieve moderate hypothermia. Cardiac arrest was achieved by giving tepid blood cardioplegia (temp. 28 °C) through coronary Ostia by using coronary ostial cannula. The native aortic valve was excised completely and the aortic annulus was totally debrided of calcium if present, before insertion of the prosthetic valve. Aortic valve size was measured with sizer at annulus per-operatively, and appropriate sized prosthesis was implanted using interrupted mattress and pledgeted 2-0 ethibond stitches. Aortotomy was closed with prolene 4-0 stitches. The data was analyzed by using SPSS V16. Quantitative variables were analyzed using mean and standard deviation and percentages were used for qualitative variables.

Dependent sample t test was used to compare aortic root annulus measured with TTE and directly with the help of sizer.

OBJECTIVE

To determine the preoperative prosthesis size using echocardiography in patients undergoing aortic valve replacement.

RESULTS

Pre-operative and per-operative Characteristics of Patients are shown in table-I. In this study, the mean age of patients was 33.77 ± 13.15 . There were more male (84%). Regarding pathology of Aortic valve disease 60% cases were due to rheumatic heart disease and 28% due to unknown cause. 40% had isolated aortic stenosis (AS), 38% patients had isolated aortic regurgitation (AR) and 22% patients had mixed aortic valve disease (MAVD).

51% patients underwent isolated Aortic valve replacement; redo-operations were done only in 4% patients. In 96% patient's mechanical prosthesis was used and in 4% patient's bio-prosthesis was used for valve replacement. We found no significant difference in Aortic annulus measured pre-operatively with the TTE ($23.54 \pm 3.54\text{mm}$) and measured per-operative with the sizer ($23.96 \pm 3.36\text{mm}$) with highly insignificant p-value 0.58. So aortic annulus sizes were almost same measured by these two techniques.

DISCUSSION

The proposed mechanisms of aortic valve disease are; Rheumatic heart disease, endocarditis and various collagen vascular diseases, innate bicuspid aortic valve and advanced age. As for as aortic regurgitation is concerned about half of the cases are due to the aortic root dilatation.¹⁴

Aortic valve disease can result in LV decomposition, raised left ventricular end-diastolic pressures, pulmonary hypertension and congestive cardiac failure. The only effective treatment for severe Aortic stenosis and in many patients with aortic insufficiency is surgical replacement of Aortic Valve.⁶

| | |
|--|---------------|
| Mean age (Mean±S.D.) | 33.77± 13.15 |
| Male sex (%) | 84.0 |
| Female sex (%) | 16.0 |
| Echo-cardio graphic Data | |
| Aortic root size | 33.75±7.28 |
| E.F. (mean±S.D.) | 55.39±10.72 |
| AoA size on TTE | 23.54± 3.54mm |
| AoA* size directly measured with sizer | 23.96±3.36mm |
| Pathology Of Valve % | |
| Rheumatic | 60.0 |
| Unknown | 28.0 |
| Calcific | 6.0 |
| Congenital | 4.0 |
| Endocarditis | 1.0 |
| Myxomatous Degeneration | 1.0 |
| Type Of Surgery % | |
| AVR** | 51.0 |
| DVR*** | 36.0 |
| AVR + CABG**** | 4.0 |
| DVR+Tricuspid Repair | 2.0 |
| MitralValveRepair+AVR | 2.0 |
| Aortic Root Replacement | 1.0 |
| Redo AVR | 2.0 |
| Redo MVR | 1.0 |
| Redo MVR+AVR | 1.0 |
| Type Of Valves Implanted % | |
| Mechanical | 96.0 |
| Bioprosthesis | 4.0 |

Table-I. Pre-operative and per-operative Characteristics of Patients.

*AoA=Aortic Annulus,
 AVR=Aortic Valve Replacement, *DVR=Double Valve Replacement, ****CABG=Coronary Artery Bypass Grafting

Most of the patients having aortic valve disease undergo open heart surgery for AV replacement. So it is important to assess aortic annulus before surgery to avoid fatal complications that may occur due to patient prosthesis mismatch.^{5,7}

In choosing the appropriate size of aortic valve prosthesis, the surgeon tries to leave the patient with minimal gradient across the valve. The aortic annulus is 3-dimensional in structure.⁵ the annulus defines the width of the root as

measured from the sizers and also the seating of the circular prosthesis because they are fixed with sutures through the nadirs of the annulus. The choice of replacement valve depends on the patient's age, concomitant disease, lifestyle, body surface area, aortic root and aortic annulus. The proper size of prosthesis must be arranged pre operatively that is necessary for patient, sometimes it is not available in hospital. In this study Aortic annulus measured with TTE was almost same as measured directly with the help of sizer preoperatively. And it helped a lot in arranging appropriate sized prosthesis before surgery.

So the size of aortic annulus should be measured before surgery to determine appropriate sized prosthesis that will result in successful implantation of aortic valve. The patient's size (body surface area, BSA) and age must be considered when choosing the appropriate aortic valve prosthesis. Small aortic prostheses may leave higher residual pressure gradients across the valve⁸ that results in Patients Prosthesis Mismatch which ranges from 2% to 10%.^{9,10} On the other hand, large prosthesis may require aortic root enlargement that may complicate an operation for aortic valve replacement.¹¹⁻¹³

CONCLUSION

Aortic annulus size measured with TTE helps to arrange the optimum size prosthesis before aortic valve replacement surgery.





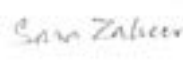
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AUTHORSHIP AND CONTRIBUTION DECLARATION

| Sr. # | Author-s Full Name | Contribution to the paper | Author=s Signature |
|-------|-----------------------|---|---|
| 1 | Ghulam Hussain | Conceived, designed and did statistical analysis & editing of manuscript. |  |
| 2 | Naseem Ahmad | Did data collection and did review and final approval of manuscript |  |
| 3 | Sohail Ahmad | Did data collection and did review and final approval of manuscript |  |
| 4 | Mirza Ahmad Raza Baig | Data analysis, did review and helped in final approval of manuscript |  |
| 5 | Sara Zaheer | Did review and helped in final approval of manuscript |  |