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Original Research Article

THE ANATOMICAL STUDY OF MITRAL VALVE ANNULUS IN THE HUMAN CADAVERIC HEARTS FOR BIOPROSTHESIS

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ABSTRACT

Introduction: The unimpeded forward flow of blood across the mitral orifice depends upon a coordinated interaction between the mitral annulus, leaflets, chordae tendinae & papillary muscle. Knowledge about the normal anatomy of mitral valve annular morphometry is important for assessing the valve pathologies and also in valve replacement surgery for a deceased valve

Materials and methods: 50 heart of embalmed adult human cadaver of both sex aged between 20-70 years were taken from the department of anatomy, VIMS & RC. Parameters measured were annular diameter, circumference, area of mitral valve by using vernier caliper, measuring scale, cotton thread & magnifying lens.

Results: In the present study mean value of mitral valve were, circumference of mitral valve was 8.19±1.01cm in males, 7.76±0.99 cms in females, diameter was 3.10±0.40 cm in males & 3.26±0.48 cm in females, area of mitral valve was 5.45±1.34 cm^2 in males & 4.89±1.20 cm^2 in females. All the parameters of mitral valve annulus like circumference, diameter & area of valve was more in males except in females the diameter was more. There was no significant difference between male & female values of mitral valve annulus.

Conclusion: Knowledge of normal measurements of the component parts of the mitral valve is essential for the surgeon during operation to assess the exact mechanical reason for valve insufficiency & in development & manufacture of prostheses for valvuloplasty.

KEY WORDS: Mitral Valve, Annulus, Bioprosthesis, Valve Replacement.

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INTRODUCTION

The atrioventricular valvular complex of left ventricles, consists of the orifice and its associated anulus, the cusps, the supporting chordae tendineae of various types and the papillary muscles. The mitral orifice is a well-defined transitional zone between the atrial wall and the bases of the cusps. The anulus of the valve is made up of fibrocollagenous elements of varying consistency from which the fibrous core of the cusps take origin. These variations allow major changes in the shape and dimensions of the anulus at different stages of the cardiac cycle and ensure optimal efficiency in valvular action [1]. Louis A. Du Plessis et al [2] described that mitral valve inlet was larger than its outlet because of the oblique setting of the plane of the outlet orifice compensates for the discrepancy in size. The mitral annulus was in close proximity to the bundle of His, the coronary sinus, the aortic cusps, and other coronary vessels. Careless suturing during total valve replacement may damage these structures. Shamim et al [3] states that the dimensions of mitral valve do not show any racial difference, in a study by Krishnaiah et al [4] demonstrate that there was a marginal difference between Indian and western subjects and minimal difference between male and female with diameter and circumference of the mitral valve. These differences would be of paramount importance to a surgeon and will be crucial when valve replacements are being considered. Tie C et al [5] reported in a study of control group of the right atrioventricular valve and in a comparative evaluation, that there were similar values for nonfixed and fixed hearts, as well as for those evaluated by echocardiograms.

The diseased mitral valve like stenosis & prolapsed of valve is replaced by a prosthetic valve. Hence detailed knowledge about the normal anatomy of annulus of mitral valve is required for manufacturing prosthetic valves of appropriate dimensions and in surgical correction of damaged heart valves.

MATERIALS AND METHODS

50 hearts were taken from previously embalmed adult human cadaveric of both sex(21 male & 29 female cadaveric hearts) of aged between 20-70 years were taken for the study from the department of Anatomy, Vydehi Institute of Medical Sciences and Research Centre, Bangalore. Cadavers with the history of any cardiac pathology were excluded from the study. Hearts which were hypertrophied, very small hearts, stenotic mitral valves were excluded from the study.

Dissection of specimens: Position and orientation of the heart and its chambers were confirmed. Left atrium was then opened by an incision through the right and left inferior pulmonary veins and the upper part of left atrial auricle was dissected. The heart thus opened was emptied of blood clots inside, washed thoroughly in running tap water. The mitral valve was inspected from above. An incision was made on the left margin of the heart and extended up to the apex of the heart. The left ventricle was opened and blood clots were removed from the left atrium. Thorough saline wash was given and bicuspid (Mitral valve) was observed and measured. The heart thus opened was emptied of blood clots inside, washed thoroughly in running tap water. In each heart a detailed examination of the mitral valve annulus was made [6].

The following parameters were measured and studied of Mitral valve

1. Annular Circumference was measured by using cotton thread at the attachment of

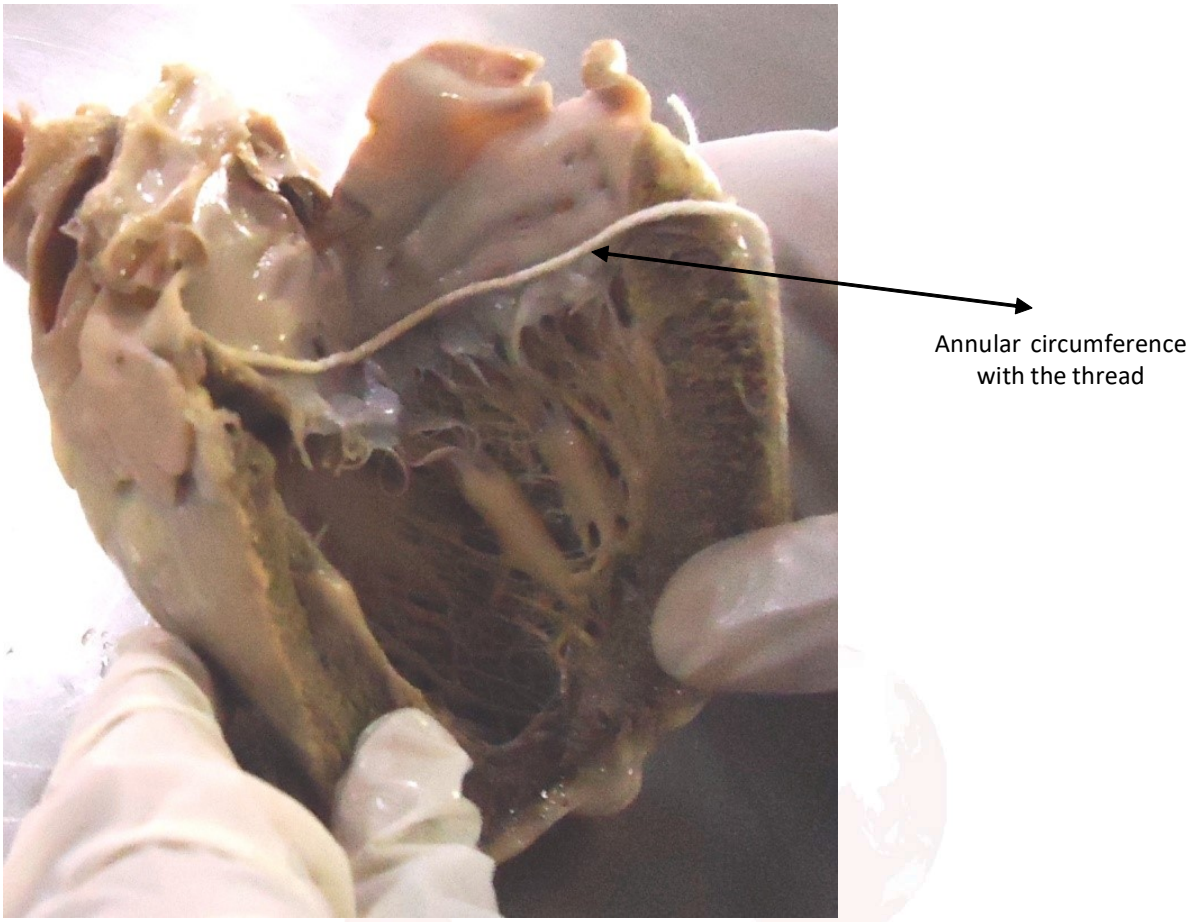
leaflet.

2. Annular diameter was measured by calliper.

3. Area of the valve: was calculated using the formula C 2 / 4$\prod$ Sq.cm (C- circumference of valve) [7].

Statistical Methods: Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Statistical software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data, Microsoft word and Excel have been used to generate graphs, tables etc.

Fig. 1: Shows measuring the annular circumference of mitral valve.



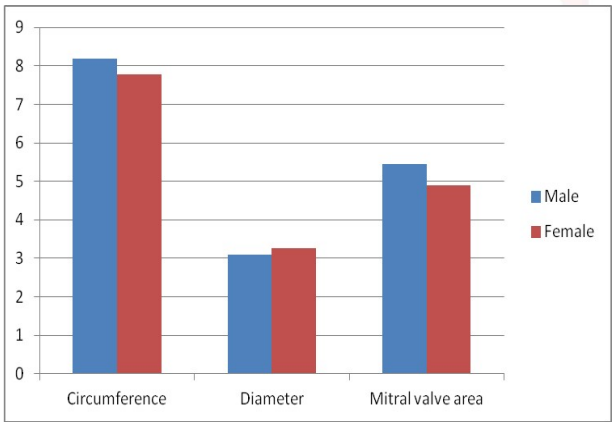
RESULTS

In each heart a detailed examination of mitral valve was made and the following parameters were measured and the results were tabulated as follows:

Table 1: Represents the parameters of Mitral valve annulus.

Variables	Minimum-maximum (cms)		Mean+SD (cms)		t -value	P - value
	Male	Female	Male	Female		
Circumference	6.7-10.4 cm	6.2-9 cm	8.19±1.01 cm	7.76±0.99 cm	1.506	0.139
Diameter	2.15-4.1 cm	2.46-4.42 cm	3.10±0.40 cm	3.26±0.48 cm	1.448	0.154
Mitral valve area	3.59-8.65cm^2	3.07-6.48 cm^2	5.45±1.34 cm^2	4.89±1.20 cm^2	1.497	0.141

Graph 1: Showing comparison of mitral valve annular circumference, diameter & area between male & female.



In the present study mean value of mitral valve were, diameter was 3.10±0.40 cm in males & 3.26±0.48 cm in females, circumference of mitral valve was 8.19±1.01cm in males & 7.76±0.99 cms in females, area of mitral valve was 5.45±1.34 cm^2 in males & 4.89±1.20 cm^{2}in females.

All the parameters of mitral valve annulus like circumference, diameter & area of valve was more in males except in females the diameter were more. Correlation coefficient & test of significant was applied showed no significent between male & female values (p>0.05)

DISCUSSION

Mitral valve circumference:

Table 2: Shows comparison of mitral valve circumference with other authors.

S.No.	Authors	No. of cadaver heart	Annular circumference
1	Brock RC et al [8]	--	10.5(9.9)
2	Rusted IE et al [9]	50	9.9
3	Cheichi et al [10]	--	10(M),9(F)
4	Duplessis LA et al [2]	10	10.2
5	Mc alpine et al [11]	--	13.4
6	Silvermen et al [12]	8-Dec	8-Dec
7	Ranganathan N et al [13]	50	9(M),7.2(F)
8	Bulkly BH& RobertsWC et al [14]	24	9
9	Carpentier et al [15]	--	1.16±0.35
10	Omriston JA et al [16]	2D echo	9.3±0.9
11	Datta Ak et al [17]	30	10.3(M),9.7(F)
12	Wesyby S et al [18]	160	9.79±1.23
13	Gerdal L et al [19]	--	10(M), 9(F)
14	Kouji chida et al [20]	--	8.3±1.0
15	Shahim et al [3]	--	10.7(M),9.16(F)
16	Sakai T et al [21]	57	9.33±1.1
17	Andrade NMM et al [22]	--	7.92
18	Henry gray et al [1]	--	9(m), 7.2(F)
19	Patil D et al [23]	50	8.24
20	Gupta C et al [24]	18	9.12±0.44
21	Senthil kumar et al [25]	45	7.92±0.14
22	Kapil amgain et al [26]	50	8.03±0.82
23	Deopujar R et al [27]	--	8.27
24	Kibria GM et al [28]	50	8.03±0.82
25	Mishra PP et al [29]	120	7.5±10
26	Ilankathir S et al [6]	50	8.29
27	Charanya N et al [30]	60	8.86±0.16
28	Gunnal SA et al [31]	116	9.12±1.36
29	Sriambika K et al [32]	50	8.8±1
30	Present study	50	8.19±1.01(M), 7.76±0.99(F)

Table 3: Shows comparison of mitral valve diameter reported by other authors.

S.No.	Authors	Cadaveric hearts	Annular diameter mitral valve in cms
1	Hamilton DJ et al [33]	60	3.5cm-3 cm
2	Broke RC et al [8]		2.5
3	Rusted IE et al [9]	50	2.5 cm(M) 2.1 cm(F)
4	Westby S et al [18]	160	3.23±0.39 cm(M) 2.90±0.27 cm(F)
5	Sakai T et al [21]	57	2.23
6	Krishniaha M et al [4]	2D echo	2.19(M), 1.96(F)
7	Gunnal SA et al [31]	116	2.22±0.50
8	Kapil amgain et al [26]	50	2.56±0.32
9	Senthil kumar B et al [25]	45	2.54±0.07
10	Sriambika K et al [32]	50	2.7±0.32
11	Present study	50	3.10±0.40 cm(M) 3.29±0.48(F)

The present study measurement of annular diameter was more than all the other studies but less compared to Hamilton DJ et al [33] & in males of Westaby S et al [18] studies. The circumference of mitral annulus was less compared to studies done by others both in males & females, more compared to studies done by Andrade NM et al M [22], Sriambika et al [32], Kibria et al [28], Mishra PP et al [29] studies. The area of mitral valve was less compared to other studies but more compared to studies done by Senthil kumar B et al [25], Mishra PPet al [29], Kapil amgain et al [26], Carpentier A et al [15] studies.

The present study, when Compared to majority of other authors we found diameter of mitral annulus was more & lesser values with circumference & area of the valve. But there was variation in the values of other parameters of mitral valve when compared to other studies. Our study mainly includes cadaveric hearts from Indian population which showed different dimensions on many above mentioned parameters when compared to the results of others study. This can be attributed to difference in age, sex, region of study, nature of specimen studied & races of the population studied. Hence the knowledge of normal measurements of the component parts of the valve is essential for the surgeon during operation in this region assessing the exact mechanical reason for valve insufficiency & in the development and manufacture of prosthesis for valvuloplasty.

Table 4: Shows comparison of mitral valve area reported by different authors.

S.No.	Authors	Cadaveric heart	Area of mitral valve
1	Chiechi, MA et al [10]	105	7.93 cm^2(M) 6.42 cm^2 (F)
2	Carpentier A et al [15]	--	3.2±1.3
3	Westaby S et al [18]	160	7.7±1.93cm^2
4	Bezzare AJC et al [34]	91	9.049 cm^2
5	Gupta C et al [24]	18	7.3(M), 6.2(F)
6	Senthil kumar B et al [25]	45	5.04±0.01
7	Kapil amgain et al [26]	50	2.56±0.32
8	Kibria GM et al [28]	37	6.89±1.24
9	Mishra PP et al [29]	120	5.1±7.5
10	Sriambika K et al [32]	50	6.2±1.46
11	Present study	50	5.45±1.34 cm^2(M), 4.89±1.20(F)

CONCLUSION

The disorders involving the valves of the heart disturbs the pumping efficiency of the heart. They produce either stenosis or regurgitation. Detailed knowledge of the anatomical characteristics of the mitral valve should improve the understanding of its anatomy and help much to

obtain the better results in conservative procedures and in this way promoting return to anatomical and functional normality. This precise knowledge also defines some details of the architecture of the mitral valve that are necessary for the development and manufacture of the prosthesis. This will be helpful for both anatomist & cardiac surgeons, in surgical procedures such as mitral valvuloplasty & prosthetic valve replacement.

Conflicts of Interests: None

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