

Morphometry of Mitral Valve and its Variations

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ABSTRACT

Introduction: Among all four valves in The human Heart, Mitral Valve connects Lt. Atrium with Lt. Ventricle. Detailed structural anatomy of it is essential for surgeons doing mitral homograft replacement as well as for corrective surgeries.

Material and Methods: 52 formalin fixed human hearts were studied, procured from cadavers in the Department of Anatomy, Motilal, Nehru, Medical College, Allahabad. Left ventricle and mitral valves were dissected and studied.

Results: In 5(9.61%) heart specimens we have found 3 cusps instead of 2(Bicuspid) cusps of mitral valve, we have found 3 prominent indentations considering it as commissures as they were deep, having attached chordae from separate papillary muscles. Average circumference of Mitral Valve is 8.136 cms (Table-1) and average height of Anterior cusp and Posterior cusp is 2.034 and 1.012cms respectively (Table-2) in eastern uttar Pradesh population

Conclusion: Average annular circumference is less in north Indians as compared to other population and average height of anterior and posterior cusps is almost matching with other populations.

Keywords: Mitral Valve Cusp, Anterior cusp, Posterior Cusp, Annular Circumference

INTRODUCTION

Among all four valves in The human Heart, Mitral Valve connects Lt. Atrium with Lt. Ventricle. Mitral valve is described as consisting of continuous Sheet like structure attached around the entire circumference of the mitral orifice with its free edge bearing several deep grooves; two are deep enough and regular to be named as commissure. The cusps are named as anterior and posterior. The anterior cusp guards one-third of the circumference of the orifice and is semicircular or triangular, with few or no marginal indentations. The posterior cusp guards two-thirds of the circumference. Other small indentations divide the posterior cusp into a relatively large middle scallop and smaller anterolateral and posteromedial commissural scallops¹.

According to text (Gray's Anatomy² 39th Edition) mitral valve mean circumference is 9.0 cm in males; 7.2cm in females. Orifice is almost vertical in diastole and at 45° to the sagittal plane with slight forward tilt. Posterior cusp has 2/3rd of circumferential attachment.

Study aimed to measure Mitral valve annulus circumference and height and length of valve cusps, useful database for prosthetic heart valve replacement surgeries and population differences in valve size can be easily observed

MATERIAL AND METHODS

formalin fixed human hearts were studied, procured from

cadavers in the Department of Anatomy MLNMC, Allahabad in 2016 Irrespective of sex and all the specimens were above 50 years of age. Ethical clearance was obtained from ethical committee of our institution. Hearts with any macroscopic abnormality, fibrosed and diseased, were excluded from our study. All the heart specimens were washed in running tap water to remove clots and blood from chambers of heart. Incision was given in 4 steps to visualise and measure mitral valve. Dissection steps are shown in (Fig-1). First step was incision in the left atrium around mitral valve annulus then incision was extended upto the apex of left ventricle and cavity opened up finally papillary muscles were divided near ventricular wall and cusps were also freed from their attachment along with mitral valve annulus and spread on black chart paper for proper measurement of length, height and annular circumference. Measurements were taken with the help of vernier calliper and thread.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the statistical analysis. Descriptive statistics like mean and percentages were used for the analysis.

RESULTS

In 5(9.61%) heart specimens we have found 3 cusps of mitral valve (Fig-2). Most common and widely accepted configuration for leaflet anatomy was the description provided by Carpentier (1976) described 3 posterior leaflet scallops with 2 clefts separating them, 2 commissures separating the anterior and posterior leaflet, and 1 anterior scallop. Any clefts that were found in regions described as being scalloped regions by the current nomenclature were termed "deviant" clefts. Our findings were based upon the above description, we have found 3 prominent indentations considering it as commissures as they were deep, having attached chordae from separate papillary

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Range in cms	6-7	7-8	8-9
Total number of Heart	6	37	9
% of Heart	11.53	71.15	17.3

Table-1: Showing Annular Circumference of Mitral Valve in cms in different ranges

Parameters (in cms)	Anterior cusp	Posterior Cusp	Accesso-ry Cusp
Average height	2.034	1.121	0.871
Average length	2.98	4.02	1.04

Table-2: Showing length and breadth of mitral valve cusp

S. No.	Annular Circumference of Mitral Valve	Max. Height of AC	Maximum height of PC
Present study	8.136	2.034	1.121
Walmsley T 1929		1.5-1.8	1-1.2
Rusted I E 1952	9.9 M 8.5 F	2.2	
Cheichi et al 1956	10 M 9 F		
RC Brock 1952	10.05	1.5-1.8	1-1.2
Mcalpine 1975	13.4 (Diastolic state heart perfusion fixation)		
Louis A Du Plessis 1964	10.1	2.7	1.3

Table-3: Showing Comparison of Present study with previous studies

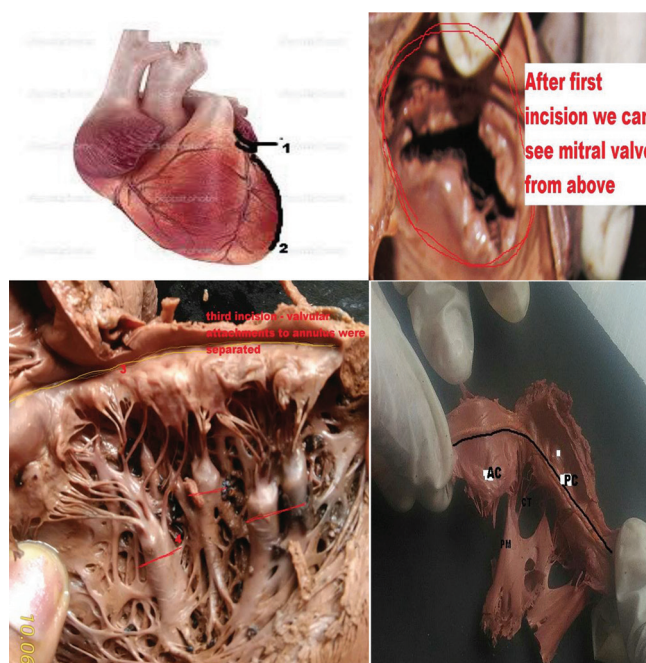
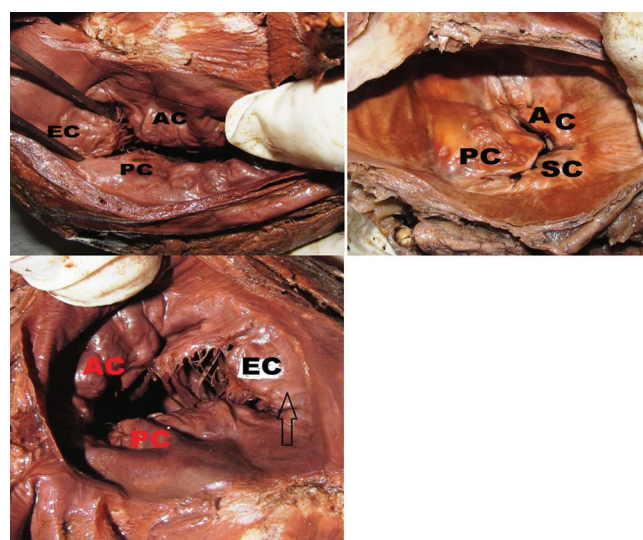


Figure-1: Showing Dissection steps (1-4)

muscles.

Average annular circumference of mitral valve was between 7-8 cms range in 71.15% hearts (Table-1). Average height and length of AC and PC was 2.034, 1.121 and 2.98, 4.02 cms respectively (Table-2).



EC- Extra Cusp AC- Anterior Cusp PC- Posterior Cusp SP- Septal Cusp

Figure-2: Showing mitral valves bearing Accessory or Extra Cusps

DISCUSSION

During development of fetal heart mesenchymal cells of endocardial heart tube around the atrioventricular canals proliferate to form endocardial cushions. The ventricular surface of the cushions is excavated to form the atrioventricular valves attaching themselves to the ventricular wall via trabeculae³. Atrioventricular valve Leaflets were developing both from the endocardial cushion tissues and the myocardium. The leaflets and trabeculae of the atrioventricular valves was formed by separation of the innermost layers of the inlet part of ventricles⁴. Victor and Nayak stated that the mitral valve apparatus is unique to each individual as one's own fingerprints⁵. Quill et al in 2009 proposed nomenclature system for cardiothoracic surgeons, dividing anterior and posterior leaflets into A1, A2, and A3 and P1, P2, and P3 scallops respectively via clefts⁶. The cleft term was used for division between scallops on anterior and posterior leaflet. Hartynski et al reported a case with parachute like accessory mitral valve leaflet and tissue attaching to the anterior leaflet, ballooning into the subaortic ventricular septum associated with a discrete subaortic membrane causing stenosis⁷. They gave emphasis upon intraoperative epicardial or transesophageal echocardiography for recognition of such defects. Rodrigo et al reported cases with double orifice mitral valve with defects in the tensor apparatus, double-parachute mitral valve having each of the 2 mitral orifices inserting into fused papillary muscles⁸. Levy et al in 1963 described 3 specimens from patients with congenitally corrected transposition having "umbrella" like formations of accessory valvular tissue into the subpulmonary area⁹. Mishra et al, 2014 described most frequent shape, it was triangular in 75-80% and in 2.5% cases, mitral valve showed accessory triangular leaflet¹⁰. Kumar et al, also classified mitral valve using numbering scheme for the scallops but carpentiers description is commonly used¹¹. We observed extra cusp or accessory cusp in 9.6% hearts having average height of 0.871 cm and length of 1.04 cm,

while average length of Anterior cusp was 2.98 cms and height was 2.034cms Post. Cusps were having average height of 1.01cms and length of 1.21cms annular circumference was 8.136cms (table-1). In comparison with other studies our study closely matches with Study by Rusted et al¹² (Table-2). Average annular circumference of mitral valve was between 7-8 cms range in 71.15% hearts (Table-1). Average height and length of AC and PC was 2.034, 1.121 and 2.98, 4.02 cms respectively (Table-2).

CONCLUSION

In our study we can infer that incidence of having extra cusp (5.96%) in north Indian population. We should keep these database in our mind before managing any patient with problems related to mitral valve complex.

There are differences in morphometric details of north Indians as compared to other populations. Average annular circumference is less and max height of anterior and posterior cusps is matching with other population studies. We can use these data for mitral valve reconstructive surgeries and valve replacement surgeries.

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