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Original Research Article

MORPHOLOGICAL AND MORPHOMETRIC STUDY OF MITRAL VALVE WITH REFERENCE TO ANATOMICAL VARIABILITY IN SOUTH INDIAN SUBJECTS

Sriambika K *[1], Virender Kumar Nim [2], Nutan Nalini Bage [3].

*[1] Assistant Professor,Department of Anatomy,Pondicherry Institute of Medical Sciences, Ganapathychettikulam, Kalapet, Pondicherry, India.

[2] Professor, Department of Anatomy, Pondicherry Institute of Medical Sciences, Ganapathychettikulam, Kalapet, Pondicherry, India.

[3] Professor, Department of Anatomy, Pondicherry Institute of Medical Sciences, Ganapathychettikulam, Kalapet, Pondicherry, India.

ABSTRACT

Background: The mitral valve (MV) is a complex structure that is altered in various disease status. Mitral valve closure prevents systolic backflow of blood from the left ventricle into atrium, which depends on the co-ordinated action of left atrium, mitral valve leaflets, annulus, chordae, papillary muscles and the left ventricular wall. Alteration in the structure and function of any of these elements lead to mitral valve incompetence.

Purpose of the study: The aim of the study was to determine the morphological and the morphometric variations of mitral valve. The present study has classified mitral valve based on the number of mitral valve leaflets/cusps and also measured the size and area of mitral orifice and mitral annulus circumference.

Methods: Present study included 50 human hearts from the cadavers in the department of Anatomy at Pondicherry Institute of Medical Sciences. Circumference, annular diameter, area of the valve, height of the anterior leaflet and height of the posterior leaflet was measured.

Results: In this study annular circumference ranged between 6.8 to11.5 cm and 64% of the circumference ranged between 8.1 to 10 cm. Annular diameter ranged between 2 to 3.6 cm and 58% of diameter ranged between 2.6 to 3 cm.Height of the anterior leaflet ranged between 1 to 2.5 cm and 54% ranged between 1.6 to 2 cm. Height of the posterior leaflet ranged between 0.5 to 1.5 cm and 70% ranged between0.5to 1cm.

Conclusion: Although the most commonly described mitral valve is bicuspid, in the present study 3 cusps were found in 4% of the specimens. Improper cusp approximation may cause cardio vascular problems. Morphometric measurements of the mitral valve will help in finding the correct size of the prosthesis for the valve replacement which will accurately fix in the valve orifice.

KEYWORDS: Mitral valve, Mitral orifice, Mitral leaflets.

Address for Correspondence: Dr. Sriambika K,Department of Anatomy,Pondicherry Institute of Medical Sciences,Ganapathychettikulam, Kalapet,Pondicherry – 605014, India.
Mobile number - +919790740776 **E-Mail:**kambika1784@gmail.com

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INTRODUCTION

The mitral valve (MV) is a complex structure that is altered in various disease status and therefore of great importance. Recently a clinical

syndrome caused by rupture of chordae tendinae of mitral valve has been recognized with increasing frequency. The location and character of resultant regurgitant murmur vary with the leaflet freed by ruptured chordae[1]. Mitral valve closure prevents systolic backflow of blood from the left ventricle into atrium, and this depends on the coordinated action of left atrium, the mitral valve leaflets, the annulus, the chordae, the papillary muscles and the left ventricular wall. Alteration in the structure and function of any of these elements lead to mitral valve incompetence. Therefore, knowledge of anatomical details and of their functional characteristics, together with the implementation is of utmost importance for diagnostic interrogation and therapeutic approach in mitral valve diseases[2].

The aim of the study was to determine the morphological and the morphometric variations of mitral valve.The present study has classified mitral valve based on the number of mitral valve leaflets/cusps and also measured the size and area of mitral orifice and mitral annulus circumference, as increase in the number of cusps and their improper approximation will more likely cause various valvular disorders like mitral regurgitation (MR). This knowledge may be useful for cardio thoracic surgeons in surgical repair of mitral valve.

MATERIALS AND METHODS

Present study included 50 human hearts from the cadavers which were embalmed by 10% formalin via femoral artery in the department of Anatomy at Pondicherry Institute of Medical Sciences. Examination was focused on the mitral valve region. The adult cadaver hearts of both genders without any obvious pathology were included. The hearts with gross pathology and traumatic damage were excluded.

The heart was taken out by incising the fibrous pericardium and the great vessels like aorta, pulmonary trunk, superior vena cava, inferior vena cava and pulmonary veins. The specimens were collected, numbered and preserved in 10% formalin solution. The visceral pericardium and epicardial fat were removed (3). Left atrium of these hearts was opened by giving a midline incision

The left atrioventricular orifice was cleared by removing the clots. Then the cavity of the left ventricle was opened and cleaned to visualize the mitral valve complex. Circumference was measured at its annulus by placing a thread hugging the annulus and the length of the thread was measured using transparent ruler graduated to 0.1 mm. Annular diameter was deducted from the calculated circumference of the mitral annulus using formulaC/π cm .Area of the valve was calculated using the formula $C^2/4\pi$ cm^2 . The height of the anterior leaflet was measured from the apex to the base. The height of the posterior leaflet was measured from the middle scallop to its base. All measurements were taken with digital calipers to the nearest 0.1 mm and expressed in millimeters and centimeters.

RESULTS

Table 1 shows the morphometry of mitral valve. In this study annular circumference ranged between 6.8 to11.5 cm and 64%of mitral valve had a circumference which ranged 8.1 to 10 cm.Table 2 shows the annular circumference of the mitral valve.Annular diameter ranged between 2 to 3.6 cm and 58%of mitral valve had a diameter which ranged 2.6 to 3 cm.Table 3 shows the annular diameter of mitral valve. Height of the anterior leaflet ranged between 1 to 2.5 cm and 54% ranged between 1.6 to 2 cm. Height of the posterior leaflet ranged between 0.5 to 1.5 cm and 70% ranged between 0.5 to 1 cm.Table 4 shows the area of mitral valve and table 5 shows the classification of mitral valve according to number of leaflets.

Table 1: Morphometry of mitral valve.

Parameters of study	Maximum	Minimum	Mean	SD
Annular Diameter (cms)	3.6	2.1	2.7	0.32
Circumference (cms)	11.5	6.8	8.8	1
Area of mitral valve (Sq. cm)	10.5	3.6	6.2	1.46
Height of the anterior cusp (cms)	2.5	1.1	1.9	0.26
Height of the posterior cusp (cms)	1.5	0.7	1	0.16

Table 2: Annular circumference of the mitral valve.

Range in cms	6.1-7	7.1-8	8.1-9	9.1-10	10.1-11	11.1-12	Total
Total No.	1	12	17	15	2	3	50
Percentage	2	24	34	30	4	6	100

Table 3: Theannular diameter of mitral valve.

Range in cms	2-2.5	2.6-3	3.1-3.6	Total
Total No.	15	29	6	50
Percentage	30	58	12	100

Table 4: The area of mitral valve.

Range in cms^2	3-5	5.1-7	7.1-9	9.1-11	Total
Total No.	13	24	10	3	50
Percentage	26	48	20	6	100

Table 5: Classification of mitral valve according to no. of leaflets.

Classification	Bicuspid	Tricuspid	Total
Total No.	48	2	50
Percentage	96	4	100

DISCUSSION

Knowledge of the normal and variant anatomy and anomalies of Mitral valve and Chordae tendinae is increasingly vital component in management of heart diseases. Mitral valve orifice is a well-defined transitional zone between left atrium and left ventricle. The present study revealed the various dimensions of mitral valve in cadaveric human hearts.

In this study 64%of mitral valve had a circumference which ranged 8.1 to 10 cm. Michael in Gray's Anatomy (2008) has quoted that mean circumference of mitral valve in males is 9 cm and in female is 7.2 cm[4]. In a study done by Ormiston et al the maximum annular circumference were 9.3 cm and 7 to 7.9 cm in 40% and 8 to 8.99 cm in 30% of the cases which correlated with the present study [5,6].

Morphometric analysis of mitral valve has been studied by various authors. A comparison of morphometric data found by different investigators in different population with the present study is shown in the table 6.

In this study annular diameter was within the range 2.6 to 3 cm which coincides with the measurements reported by Krishnaiah et al [7]. This is similar to the reports by Senthil Kumar which stated the annular diameter in cadaveric heart was 2.54 cm[8]. S.A Gunnal stated that mean annular diameter was2.22cm which also coincides with the present study[9]. These findings are similar to studies by Rusted I.E and Sakai T [10,11].

The height of the anterior leaflet ranged between 2.1 – 2.5 cm in 40% of heart specimens which was less as compared to R.C Brock, but was similar to the findings by Lousis A Du Plessis, E.W.T Morris [12-14]. 70% of the height of the posterior leaflet in this study ranged between 0.5 – 1 cm which is comparatively lower than E.W.T Morris , Rusted I.E and similar to the studies done by Walmsley T,R.C Brock and Ranganathan et al [14,10,15,12,2].In the present study accessory cusp were found in two cases. The length of the accessory cusp was 0.7 cm and 0.8 cm.

The morphometric measurements in present study compared with other studies can help in making prosthesis of the exact size of the valves. Mitral valve prosthesis consists of support house with two leaflets. Support house is sutured to annulus of mitral valve of patient tissue. Circumference of the annulus plays a role in prototype manufacture of support house. An exact measurement of the valve prosthesis with reference to human valve measurements plays a primary role in designing and manufacturing. Meticulous knowledge of anatomical and functional features of mitral valve is essential to construct an entirely whole mitral valve from autogenous grafts [16].

Table 6: Comparison of morphometry of mitral valve.

Various studies	Year	Annular diameter	Circumference	Area of MV	Max. height of anterior cusp	Max. height of posterior cusp
Walmsley T	1929	-	-	-	1.5-1.8	1-1.2
R.C Brock	1952	-	10.05	-	1.5-1.8	1-1.2
Rusted I.E	1952	2.5	9.9	-	2.2	1.25
Chiechi	1956	-	10	-		
E.W.T Morris	1960	-	-	-	2.7	1.3
Louis A DuPlessis	1964	-	10.1	-	2.7	1.3
Bulkley and Roberts	1975	-	9	-	-	-
J.A.Ormiston	1981	-	9.3	-	-	-
Sakai T	1999	2.23	9.33	-	-	-
Gunnal S.A	2011	2.22	9.12	-	1.96	1.5
Gupta C	2012		9.1	7.3	-	-
Present study	2015	2.7	8.8	6.2	1.9	1

CONCLUSION

Although the most commonly described mitral valve is bicuspid, in the present study 3 cusps were found in 4% of the specimens. Improper cusp approximation may cause cardio vascular problems. Morphometric measurements of the mitral valve will help in finding the correct size of the prosthesis for the valve replacement which will accurately fix in the valve orifice.

Conflicts of Interests: None

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