

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Morphomeric Study of Mitral Valve of Human Heart.

L Nayak*, S Senapati, D Agrawal, BB Mohanty, L Pattnaik, and PK Chinara.

Department of Anatomy, IMS & SUM Hospital, SOA University, Bhubaneswar-751003, Odisha, India

ABSTRACT

Left atrioventricular orifice is present between the left atrium and left ventricle and it is guarded by the mitral valve. As the valves vary from individual to individual, the objective of the study is to find the normal morphological value of this region. With this in mind, the present study measuring the dimensions of mitral valve was conducted in the department of Anatomy, IMS and SUM Hospital, Bhubaneswar. 50 formalin preserved hearts were collected from the department of FMT, SCB Medical College, Cuttack. These samples were obtained from unclaimed bodies and were collected within 6-12 hours after death. The mitral valves were dissected & annular circumference, annular attachment of each leaflet, annular area were calculated. The height of each leaflet was measured from the base to its free edge in the central axis. The findings were tabulated & statistically analysed.

Keywords: mitral valve, measurements, anterior, posterior, leaflets, morphometry, heart.

**Corresponding author*



INTRODUCTION

The study of the heart and great vessels has come a long way since the days of Andreas Vesalius, the great sixteenth century anatomist who recognized the impact of anatomy on the practice of medicine [1]. Diseases and disorders of the heart valves constitute a major worldwide cause of disability, reduced quality of life and premature mortality from cardiovascular diseases [2]. In developing countries, the majority of cases of rheumatic valve disease affect the mitral valve, with mitral stenosis being the most common lesion in adults. In children aged 5 years and younger, mitral regurgitation is the most common cardiac manifestation in developing countries [3]. The present study involves the measurements of morphological dimensions of mitral valve. As already known, the mitral valve has an area of 4-6cm², having 2 cusps or leaflets; the anteromedial leaflet and the posterolateral leaflet which guard the left atrioventricular opening. The opening is bounded by a fibrous ring called the annulus. These leaflets are protected from prolapsing into left atrium by thread like structures called chordae tendinae which are attached at one end to papillary muscles and other end to valve cusps. There are many diseases of the heart which affect the valves like stenosis or regurgitations or also prolapse of leaflets resulting in valvular insufficiency. These diseases will require repair of the valve and if repair is not possible as in case of severe diseases like Rheumatic valve diseases, endocarditis etc. valve replacement surgery will have to be performed. Hence the patient's diseased valve is replaced by prosthetic valve which may be a metallic or a biological valve. In either case, for better selection of prosthesis the exact anatomy of the mitral valve is needed. So, an effort has been made in this paper to measure the mitral valve and its leaflets using conventional manual methods which may be of interest to anatomist and surgeons. Familiarity with normal measurements of the valve and its components can be applied to improve several surgical repair techniques and in valvular replacement.

Materials and methods

The study included 50 formalin preserved autopsy hearts obtained from the department of F.M.T, SCB Medical College, Cuttack. All the autopsy hearts fulfilled the following criteria:

- The specimens were obtained within 6-12 hrs of death.
- Only those hearts were included in the study which showed no apparent signs of valvular disease or deformity
- The specimens were obtained from unclaimed dead bodies.
- The specimens used belonged to both sexes (17 female and 33 male specimens).
- Total weight of the heart was recorded by using baby weighing machine.
- The hearts were preserved in the formalin solution.
- Mitral valve was exposed by opening the left ventricular cavity by excising the right ventricle & then giving an incision along the postero - medial commissure and the interventricular septum.

- The following measurements were taken from the dissected hearts
 - Circumference of the annulus of Mitral valve
 - Length of free margin of Anterior & Posterior leaflets.
 - Height of each leaflet measured at its centre, from free edge to base.
 - Total area of Mitral valve was calculated by fixing the leaflets on the graph paper and the enclosed squares were counted.

Measurements were taken with dividers, metric rule and surgical silk thread. All the above findings were calculated and statistically compared between male and females.



Figure 1: Dissection of Mitral valve

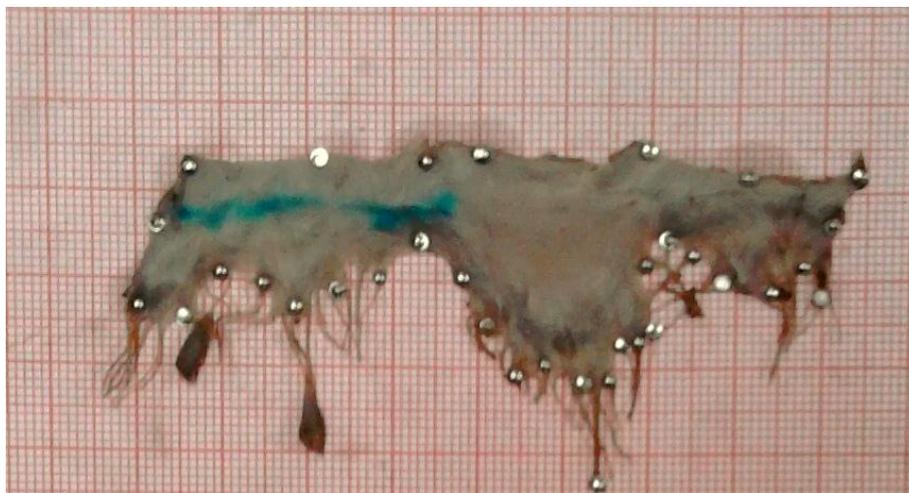
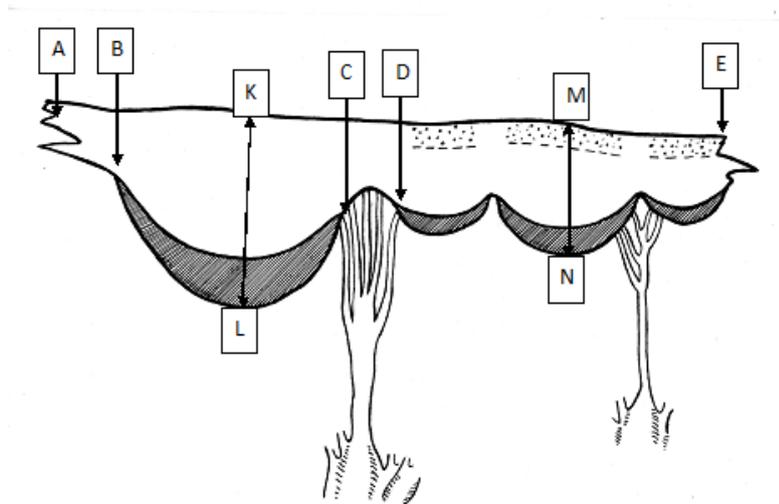


Figure 2: Measurement of area of mitral valve



BC : Length of anterior leaflet , DE : Length of posterior leaflet
 KL : Height of anterior leaflet , MN : Height of posterior leaflet

Figure 3: Graphical representation of Mitral valve for measurements

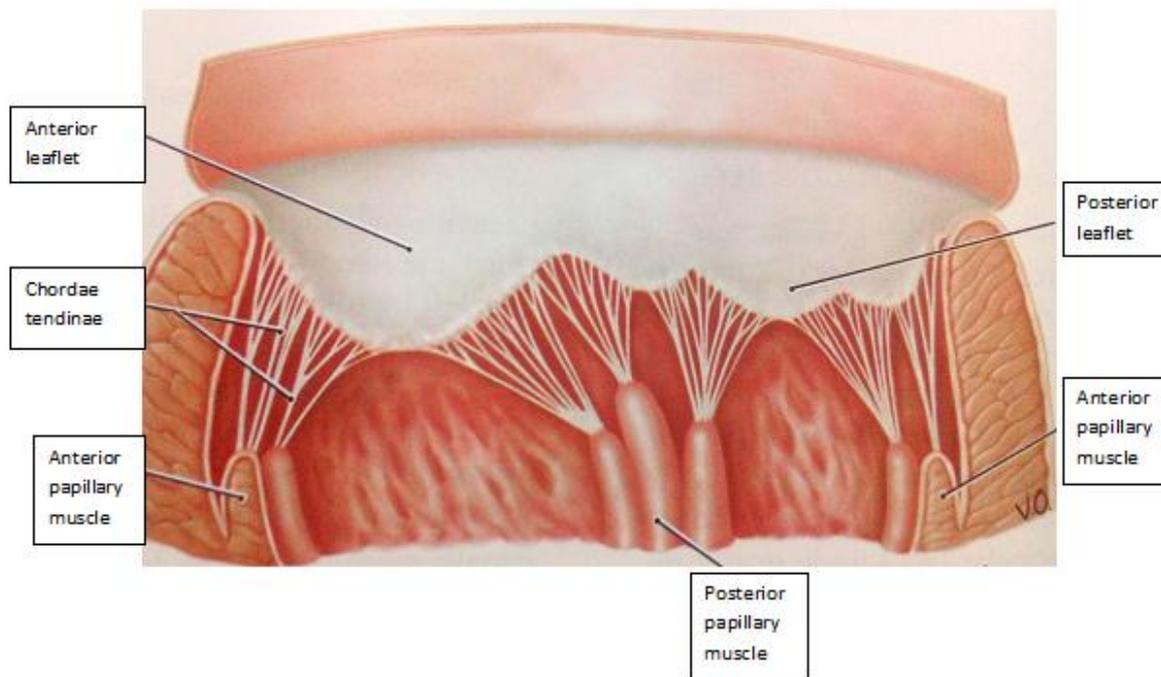


Figure 4 : Mitral valve complex showing its components (from Grant’s Atlas of Anatomy. Page – 61)

Observations

As seen in tables 1 & 2, the mean annular circumference was found to be 7.43 ± 0.37 cm in females and 7.92 ± 0.50 cm in males. In annular circumference the statistical differences were observed between male and female ($p < 0.01$). The length of the anterior leaflet was found to be 2.74 ± 0.11 cm in females and 2.87 ± 0.15 cm in males. The length of the posterior leaflet was found to be 1.76 ± 0.15 cm in females and 1.84 ± 0.13 cm in case of males. Significance differences were also observed between male and female in the length of anterior and posterior leaflets ($p < 0.01$). The height of the anterior leaflet was found to be 1.45 ± 0.11 cm in case of females and 1.53 ± 0.12 cm in males. Posterior leaflet height was found to be 1.38 ± 0.13 cm in females and 1.43 ± 0.12 cm in males. Significant differences were observed in the height of anterior leaflet ($p < 0.05$) but no significance differences were observed in the height of posterior leaflet ($p > 0.05$). Area of mitral valve in case of males was found to be 5.01 ± 0.63 cm² and in females it was found to be 4.40 ± 0.45 cm² ($p < 0.01$)

Table 1: Morphometric measurements of female mitral valve (n = 17)

	A.C (cm)	Length(cm)		Height(cm)		Area (cm ²)
		Ant	Post	Ant	Post	
Mean	7.43	2.74	1.76	1.45	1.38	4.40
SD	0.37	0.11	0.15	0.11	0.13	0.45
SE	0.09	0.0	0.04	0.03	0.03	0.11

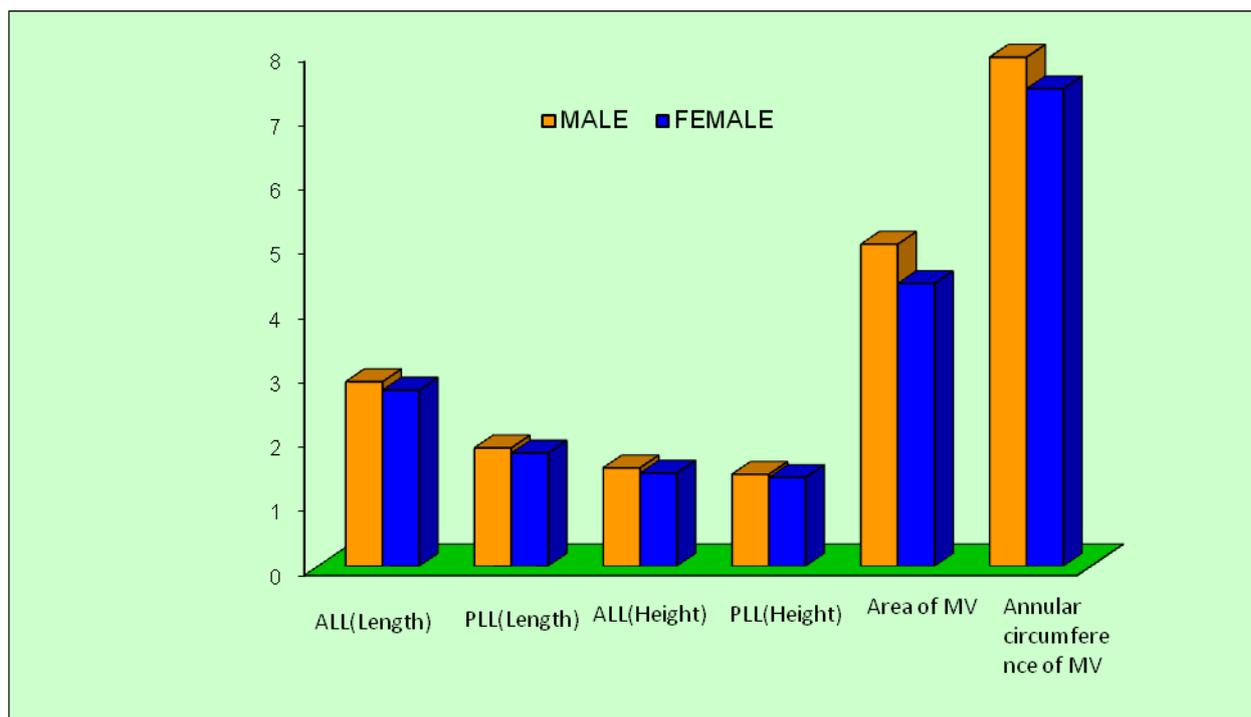
Table 2: Morphometric measurements of male mitral valve (n = 33)

	A.C (cm)	Length (cm)		Height (cm)		Area (cm ²)
		Ant	Post	Ant	Post	
Mean	7.92	2.87	1.84	1.53	1.43	5.01
SD	0.50	0.15	0.13	0.12	0.12	0.63
SE	0.09	0.03	0.02	0.02	0.02	0.11

Table 3: Comparison between male and female data

	A.C (cm)	Length (cm)		Height (cm)		Area (cm ²)
Mean difference	0.49	0.13	0.08	0.08	0.05	0.60
t-test	3.54	3.20	2.05	2.38	1.45	3.50
Significance (P value)	<0.01**	<0.01**	<0.05*	<0.05*	>0.05 (ns)	<0.01**

A.C: Annular Circumference of Mitral valve
 *** very very significant ** very significant * significant



ALL: Anterior leaflet, PLL: Posterior leaflet
 MV: Mitral valve

Figure 5: Graph showing the different measurements of Mitral valve in male and female hearts.

DISCUSSION

Many studies have been carried out to determine the normal measurements of the valves of heart. These measurements will be helpful to surgeons and radiologists, so that they can measure the dimensions of the valves and how they differ from the normal valves.

In this study, 50 formalin preserved cadaveric hearts obtained from the Forensic Medicine Department. They were dissected in the Department of Anatomy, IMS & SUM Hospital. The left ventricle was cut and the mitral valve was exposed by giving an incision along the posteromedial commissure & the interventricular septum.

In the present study the mean circumference of the mitral annulus in males was 7.92 ± 0.50 cm and in females it was 7.43 ± 0.37 cm. Kitzman et al [4]. said that, mitral annulus circumference is more in males than females. Gupta et al [5]. found that the mean circumference of mitral valve was 9.11 ± 0.44 cm. Our measurements are corresponding and comparable with B. Senthil kumar and A. Anand [6], which was found to be 7.92 ± 0.14 cm. Our measurements also correspond with a study by Bulkley and Roberts [7], which ranged between 7-11 cm, a mean of 9 cm.

According to Ranganathan et al. [8], the length of the anterior cusp in males was ranged between 2.5 – 4.8cm with a mean of 3.6 cm and posterior cusp was ranged between 1.3 – 3.8 cm with a mean of 2.3 cm. In females the length of the anterior cusp was ranged between 1.6-2.5 cm with a mean of 2.1 cm and that of posterior cusp was ranged between 1.8 – 4.2cm with an average of 2.9 cm. Present study shows the mean annular attachment of anterior cusp in male is 2.87 ± 0.15 cm & in females 2.74 ± 0.11 cm and the mean annular attachment of posterior cusp in male is 1.84 ± 0.13 cm & in females 1.76 ± 0.15 cm.

Ranganathan et al. [8] found that the height of anterior cusp in males ranged between 2.0 – 3.0 cm with a mean of 2.4 cm and in females it was ranged between 1.8 – 3.5 cm with a mean of 2.2 cm. the height of posterior leaflet in males was ranged between 0.9 -2.0 cm with a mean of 1.4 cm and in females it ranged between 0.7 -1.8 cm with a mean of 1.2 cm. According to Rusted et al.⁹, the height of the anterior cusp in males was ranged between 1.6-2.9 cm with a mean of 2.3 cm and posterior cusp was ranged between 0.8-1.8 cm with a mean of 1.3 cm. In females the height of the anterior cusp was ranged between 1.6-2.5 cm with a mean of 2.1 cm and that of posterior cusp was ranged between 0.7-2.4 cm with an average of 1.2 cm. Present study shows they as 1.53 ± 0.12 cm, 1.43 ± 0.12 cm in males & 1.45 ± 0.11 cm, 1.38 ± 0.13 cm in females.

Krishnaiah et al. [10] reported the area of mitral valve by echocardiographic study which was 4.73cm^2 in males and 3.94cm^2 in females. According to Gupta C et al. [2] total mitral valve area is 7.37cm^2 . Louis A et al. [11] stated that the average surface area of the anterior leaflet was 4.9cm^2 and of the posterior leaflet was 5cm^2 . The average surface area of both leaflets was 10cm^2 . According to Senthil et al. [6] the area of the mitral valve in cadaveric hearts is $5.04 \pm 0.01\text{cm}^2$ and autopsied hearts $6.37 \pm 0.02\text{cm}^2$. Present study shows the mitral valve area is $5.01 \pm 0.63\text{cm}^2$ in males and $4.40 \pm 0.45\text{cm}^2$ in females. Some of the observations are found to have a smaller or greater value than that of other workers. This may be due to

- There may be differences in the method of measurements.
- The lower socio-economic status from which the hearts were obtained
- Inherent genetic variation between the populations studied.

CONCLUSION

In the present study efforts have been made to determine the dimensions of the normal heart valves and to correlate these with gross cardiac parameters which can be determined by noninvasive imaging techniques like Echo & MRI. In present study we get average measurements of annular circumference, annular attachment of cusps, height of each leaflet and area of mitral valve. Basing on the premise and outcome of the study it can be agreeably stated that the parameters applicable to the male outnumber those of female as a whole in all respects. The present study involved only 50 specimens and to arrive at a definite conclusion, a more expansive and detailed study has to be undertaken. The results of the present work are to be correlated with that of the higher imaging techniques to arrive at a better conclusion and make better prosthesis of heart valve complex by Biomedical Engineers for the betterment of mankind.

REFERENCES

- [1] Callahan JA, Key JD. Foundation of cardiology .In: Giuliani ER , Fuster V , Gersh BJ , et al , eds. Cardiology fundamental and Practice , 2nd ed: Vol 1. St Louis: Mosby – Year Book; 1991: 3 – 25.
- [2] Carapatis JRN Engl J Med 2007; 2007 ; 357 : 439 – 441.
- [3] Chockalingam A, Prabhakar D, Dorairajan S, et al. J Heart valve Dis 2004; 13: 11 – 14.
- [4] Kitzman DW, Scholz DG, Hagen PT, Ilstrup DM and Edwards WD. Mayo Clin Proc 1988;63(2):137-46
- [5] Gupta C, Shetti VR, Manju BVM. J Morphol Sci 2013;30(1):6–10
- [6] Senthil B, Anand A. Int J Pharm Biosci 2013;4(4):105 – 110
- [7] Bulkley BH, and Roberts WC. American J Med 1975;59:457-63.
- [8] Ranganathan N, Lam JHC, Wigle ED, Silver MD. Circulation 1970;41:459-467.
- [9] Rusted Ian E, Charles H, Scheifley, Jesse E, Edward. Circulation 1952;6:825-31.
- [10] Krishnaiah M, Mrudula C. Int J Pharm Biosci 2011;2(1):181 – 187.
- [11] Louis A, Du Plessis, Paul Marchand. Thorax 1964;19:221 – 227
- [12] Pant P, Mukhia R, Kumari NH, Mukherjee A. Indian J App Res 2013;3(5):497 – 498.
- [13] Chiech MA, Lee WM, and Thompson R. J Thor Surg 1956;32(3):378 – 98.
- [14] Patil D, Mehta C, Prajapati P. Int J Cardiol 2009;7:2.