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Anatomy

MORPHOMETRY OF MITRAL VALVULAR COMPLEX OF ADULT IN INDIAN POPULATION

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ABSTRACT **INTRODUCTION:** Valvular diseases of heart constitute a major worldwide cause of disability and premature deaths from cardiovascular diseases. Mitral valve guards the left atrioventricular orifice and has 2 cusps , anterolateral and posteromedial . **MATERIAL AND METHODS :** Thirty formalin fixed hearts without any gross malformation or pathology were used in the study. Circumference, cross-sectional area, length of annulus, length and height of cusps of mitral valves were measured and analyzed. **OBSERVATIONS :** The circumference of mitral valves averaged 8.94±0.94 (range 7.3-11.1).The shape of the anterior leaflet was observed to be roughly triangular with height average 2.31±0.27 and width average 3.22±0.39. Posterior leaflet is roughly quadrangular in shape with the height average 1.24±0.32 and width average 2.1±0.39.The average of area is 6.15±1.31.**DISCUSSION :** Morphometry of valves thus calculated is essential information for manufacturing of prosthesis valve .

KEYWORDS : Morphometry ,mitral valve, prosthetic valve ,Indian population.

INTRODUCTION

Valvular diseases of heart constitute a major worldwide cause of disability and premature deaths from cardiovascular diseases. Mitral valve guards the left atrioventricular orifice and has 2 cusps ,anterolateral and posteromedial .Morphometry of valve is important in valve replacement for intervention and development of prosthesis in mitral regurgitation and stenosis in rheumatic heart diseases and mitral valve prolapse. The discriptions of normal valves found in the literature are difficult to follow because the best ones are given by workers who limit themselves to only one or two cusps and due to lack of studies . The artificial valve may be a metal type or tissue type. The metal type or mechanical type is made up of stainless steel alloys,molybdenum, pyrolytic carbon, silicon, teflon or polyster.

The tissue type or biological type can be an allograft in which the human cadaveric valves (mitral, pulmonary) are transplanted, or an autograft in which the patient pulmonary valve, fascia lata or pericardium is transplanted.The biological prosthesis can also be a xenograft in which the porcine mitral or bovine pericardium is transplanted. For selection and synthesis of prosthesis proper morphometry of the valve is essential.

MATERIAL AND METHOD

30 formalin(10%) fixed hearts were dissected & data was collected. Normal adult human hearts without any malformation or pathology were included in the study. Specimens were numbered & valves were dissected out.

3 incisions are given:

1st incision was taken from middle of left atrium, passing along lower margin of left coronary sulcus until tip of auricle(Figure 1).

2nd incision extended along left border of heart until its apex curved along left of ant interventricular groove until left coronary sulcus. Flap so obtained was turned to rt & lt ventricular chamber was entered. Finally papillary muscle of both ventricles were divided near its wall attachments & the cusps were freed(Figure 1).

3rd incision was taken along outer margin of annulus of mitral valve(Figure 2).

Valvular rings along with cusps were put on plastic sheet & spread(Figure 3). The length of the annulus was measured with the help of thread & Vernier's Caliper scale. Height was measured with help of a scale. Applying the formula for circumference(2πr)[1],radius is calculated and by knowing the radius area of the valve is calculated $A=\pi r^2$.

OBSERVATION Table 1

S.No.	circumference 2	Anterior cusp H	Anterior cusp W	Posterior cus H	Posterior cusp W	RADIUS r	AREA .
Range	7.3-11.1cm	1.7-2.8cm	2.6-4.2cm	0-1.8cm	1.3-2.8cm	1.1-1.7cm	4.2-9.7cm²
Average	8.9cm	2.3cm	3.2cm	1.2cm	2.1cm	1.4cm	6.1cm²
Standard	0.9cm	0.2cm	0.3cm	0.3cm	0.3cm	0.1cm	1.3cm²

Figure 1

Figure 2

Figure 3

Figure 4

The circumference of the mitral valve averaged 8.94 cm with the standard deviation of 0.94 cm with the minimum circumference of 7.3 cm and maximum circumference of 11.1.

Circumference =2πr ,with the help of this equation r (radius) is calculated .The value of radius is used to calculate the cross-sectional area using the formula for cross-sectional area =$A=\pi r^{\wedge 2}$.

The shape of anterior leaflet was observed to be roughly triangle with truncated apex (Figure 4). It has a free margin with no indentations .The average of height of anterior valve is 2.31 cm with the standard deviation of 0.27cm and the range of height is 1.7 cm to 2.8 cm .The average of width of anterior leaflet is 3.22cm with the standard deviation of 0.39cm and the minimum width is 2.6 cm and the maximum width is 4.2 cm

The posterior leaflet is roughly quadrangular in shape as a whole & was divided into scallops ranging in no. from 1-5 (Figure 4). The average of height of posterior valve is 1.24 cm with the standard deviation of 0.32cm and the range of height is 0cm to 1.8 cm .The average of width of posterior leaflet is 2.1cm with the standard deviation of 0.39cm and the minimum width is 1.3 cm and the maximum width is 2.8 cm

As the circumference of mitral valve is 2πr ,from this the radius of the mitral is calculated .The average of radius is 1.41 cm with the standard deviation of 0.14cm and the range of 1.16 cm and 1.76 cm .
From radius , we calculated the area of mitral valve which is one of the important parameter for the formation of prosthetic valve.The area of the mitral valve averaged 6.15 cm^2 with the standard deviation of 1.31cm^2 with the wide range of 4.22cm^2 and 9.73 cm^2 .

COMPARISON GRAPH SHOWING CORRELATION BETWEEN CIRCUMFERENCE ,HEIGHT ,WIDTH AND AREA OF LEAFLETS

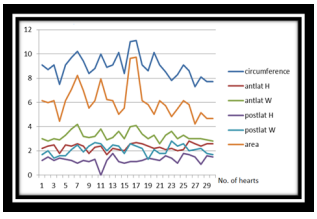

Figure 5

DISCUSSION

The present study correlates with all the studies given in the table 2 below however it also shows similarities with the dynamic studies done by Ormiston at al[7].Morphometric study will provide base line data with reference to the severity of the reduction in valvular lumen in cases of stenosis and in treatment plan. Area of valves thus calculated is essential information for manufacturing of prosthesis . Most of the studies are pertaining to 2-dimensional or 3-dimensional echocardiography where the measurements are noted during cardiac cycle . Looking into paucity of studies done in indian population this study is conducted. Exact measurements of valve prosthesis with reference to human valve measurements are the primary data for designing and of manufacturing.It is relevant to mention here that the measurements carried out in the study are on formalin fixed static hearts and they are manually taken. However in real-time studies,the valves, annulus, cusps are in a dynamic state in a cardiac cycle. Hence, the measurements two-dimensional, three-dimensional echo findings may differ from the static valve studies.

COMPARISON OF DATA FROM DIFFERENT AUTHORS

Table 2

AUTHORS	CIRCUMFERENCE	AREA	ANTCUSP HEIGHT	ANT CUSP WIDTH	POST-CUSP HEIGHT	POST-CUSP WIDTH
Michael in Gray's Anatomy[3]	9cm in males 7.2cm in females					
Patil et al[4]	8.24cm		1.92cm	3.32cm	1.10cm	4.92cm
Louis A Du Plessis[5]	10.2cm		2.7cm	3.5cm	1.3cm	6.7cm
P P Mishra et al[6]	7.51cm	6.28cm^2	2.42cm	3.22cm	1.58cm	5.73cm
Ormiston et al [7] 2D study	9.3 cm	7.1cm^2				
Present study	8.9cm	6.1cm^2	2.3cm	3.2cm	1.2cm	2.1cm

CONCLUSION

1. Mitral valve prosthesis consists of a support house with two leaflets. Support house is sutured to annulus of mitral valve of patient tissue. Circumference of the mitral annulus plays a role in prototype manufacture of support house.
2. This data help the clinicians in correlation between anomalous & normal valves as it forms the baseline for comparision .
3. There is a positive correlation between circumference and height and width of cusps.

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