Section: Anatomy

Original Research Article

MORPHOLOGICAL AND MORPHOMETRIC STUDY OF MITRAL AND TRICUSPID VALVES IN HUMAN CADAVERIC HEARTS AND ITS CLINICAL SIGNIFICANCE

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ABSTRACT

Background: Detailed anatomical knowledge of the mitral and tricuspid valves is essential for understanding valvular pathologies, prosthetic valve design and reconstructive cardiac surgeries. The aim is to study the morphology and morphometry of mitral and tricuspid valves in adult human cadaveric hearts and evaluate their clinical significance.**Materials and Methods:** A descriptive cadaveric study was conducted on 50 adult human hearts. Morphological parameters such as number of cusps and commissures were observed. Morphometric measurements including annular circumference, leaflet dimensions, rough zone, clear zone and commissural lengths were measured using digital verniercalipers and silk thread.**Result:** The tricuspid valve showed normal tricuspid morphology in 88% specimens, while 12% demonstrated accessory cusps. The mitral valve was bicuspid in 90% specimens and showed variations in 10%. The mean annular circumference of the tricuspid valve was 10.25 cm and mitral valve was 9.1 cm.**Conclusion:** Variations in morphology and morphometry of atrioventricular valves are clinically significant in valve repair, prosthetic sizing and transcatheter interventions.

INTRODUCTION

The mitral and tricuspid valves regulate unidirectional blood flow between the atria and ventricles and play an essential role in maintaining normal cardiac hemodynamics. Precise anatomical knowledge of these atrioventricular valves is important for understanding valvular heart diseases, prosthetic valve design and surgical repair procedures.[1]

Morphological variations involving leaflet number, annular dimensions, commissures and leaflet zones may influence valvular competence and postoperative outcomes.[2] Recent advances in valve repair surgery, transcatheter interventions and three-dimensional imaging techniques have increased the importance of detailed morphometric data.[3]

The tricuspid valve demonstrates significant anatomical variability with contemporary imaging studies reporting two to six leaflets in different individuals.[2] Similarly, variations in the morphology and scalloping pattern of the mitral valve have important implications during reconstructive procedures and annuloplasty surgeries.[4]

Cadaveric studies provide valuable baseline anatomical information that complements modern imaging modalities such as three-dimensional echocardiography, cardiac CT and MRI.[5]

Therefore, the present study was conducted to analyze the morphology and morphometry of mitral and tricuspid valves in adult human cadaveric hearts and to correlate the findings with their clinical significance.

Aim: To study the morphology and morphometry of mitral and tricuspid valves in adult human cadaveric hearts and to evaluate their clinical significance.

Objectives

1. To observe morphological variations in mitral and tricuspid valves.
2. To measure the annular circumference of mitral and tricuspid valves.
3. To measure annular length and height of valve leaflets.
4. To study the dimensions of rough zone and clear zone of valve leaflets.
5. To measure commissural lengths of mitral and tricuspid valves.

6. To correlate morphometric findings with clinical and surgical significance.

MATERIALS AND METHODS

Study Design: Descriptive cadaveric study.
Study Material: Fifty adult human cadaveric hearts preserved in formalin were obtained from the Department of Anatomy, Government Kilpauk Medical College, Chennai.

Inclusion Criteria
- Adult cadaveric hearts of both sexes.
- Specimens without gross deformity.

Exclusion Criteria
- Calcified valves.
- Decomposed specimens.
- Damaged cardiac specimens.

Instruments Used
- Standard dissection instruments
- Digital verniercalipers
- Surgical silk thread

Methodology: The right atrium was opened to expose the tricuspid valve. Morphological features including number of cusps and commissures were observed. Annular circumference was measured using silk thread. Leaflet dimensions, rough zone, clear zone and commissural lengths were measured using digital verniercalipers.
The left atrium was then opened to expose the mitral valve. Similar parameters were measured using identical methodology.

RESULTS

Figure 1: measurement of height of the posterior leaflet of tricuspid valve

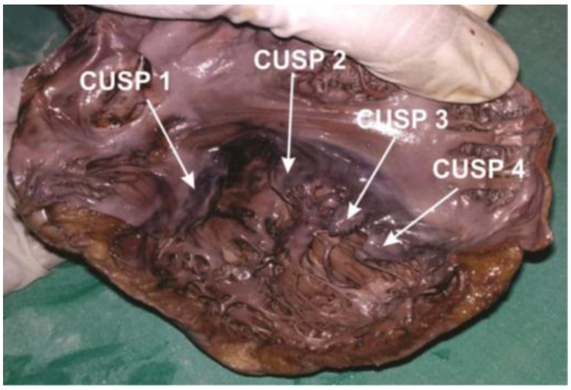

Figure 2: shows tetracuspid in a tricuspid valve

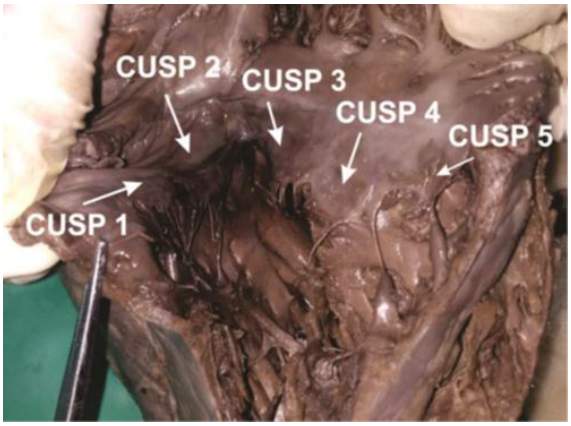

Figure 3: shows pentacuspid in a tricuspid valve


Figure 4: shows mono cuspid mitral valve.

Table 1: Morphological Variations of Tricuspid Valve and Mitral Valve

Tricuspid Valve		**Mitral Valve**	
Morphology	**Number of Specimens**	**Morphology**	**Number of Specimens**
Tricuspid	44 (88%)	Bicuspid	45 (90%)
Tetracuspid	4 (8%)	Monocuspid	2 (4%)
Pentacuspid	2 (4%)	Tricuspid	3 (6%)
Total	50 (100%)	Total	50 (100%)

Most specimens showed normal tricuspid morphology. Accessory cusps were observed in 12% of specimens. The majority of mitral valves showed normal bicuspid morphology, while 10% exhibited variations.

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Table 2: Annular Circumference of Tricuspid Valve and Mitral Valve

Measurement (cm)	Annular Circumference (cm)	
	Tricuspid Valve	Mitral Valve
Mean	10.25	9.1
Maximum	11	10.2
Minimum	9.8	8.6

The tricuspid valve demonstrated a larger annular circumference compared to the mitral valve. The annular circumference of the mitral valve was comparatively smaller than the tricuspid valve.

Table 3: Measurements of Tricuspid Valve Leaflets

Leaflet	Annular Length (cm)	Height (cm)	Rough Zone (cm)	Clear Zone (cm)
Anterior	3.53 (3.1 – 3.9)	2.05(1.7-2.4)	0.65 (0.4-0.9)	0.87(0.6-1.2)
Septal	3.21(2.8-3.4)	1.39(0.9-1.7)	0.57(0.3-0.8)	0.56(0.4-0.8)
Posterior	2.32(1.8-2.5)	1.68(1.4 -2.0)	0.67(0.4-0.9)	0.80(0.6-1.1)

The anterior leaflet was the largest leaflet, while the septal leaflet showed the least height.

Table 4: Commissural Measurements of Tricuspid Valve

Commissure	Mean Length (cm)
Anteroseptal	0.58 (0.3 - 0.8)
Septoposterior	0.68 (0.4 - 0.9)
Posteroanterior	0.57 (0.3 - 0.9)

The septoposterior commissure demonstrated the greatest mean length.

Table 5: Measurements of Mitral Valve Leaflets

Leaflet	Annular Length (cm)	Height (cm)	Rough Zone (cm)	Clear Zone (cm)
Anterior	3.27(2 - 4.5)	2.60 (2 – 3.2)	0.82(0.5 – 1.3)	1.80(1.4 – 2.4)
Posterior	6.02 (5.6 – 6.4)	1.52 (0.3 – 2.4)	0.74(0.4 – 1.3)	0.53(0.3 – 0.9)

The posterior leaflet showed the greatest annular attachment, whereas the anterior leaflet had greater height.

Table 6: Commissural Measurements of Mitral Valve

Commissure	Mean Length (cm)
Anterolateral	0.87 (0.5 – 1.6)
Posteromedial	0.77 (0.3 – 1.4)

The anterolateral commissure showed greater mean length than the posteromedial commissure.

DISCUSSION

The present cadaveric study evaluated the morphology and morphometry of mitral and tricuspid valves in 50 adult human hearts. The findings were compared with previous cadaveric morphometric studies available in literature.

In the present study, normal tricuspid morphology was observed in 88% of specimens, while accessory cusps were identified in 12% of cases. Similar findings were reported by BabitaKujur et al. and Rohilla et al., who observed accessory cusps and leaflet variations in the tricuspid valve.[6,7] Recent three-dimensional echocardiographic studies have further emphasized that the tricuspid valve demonstrates marked anatomical variability with multiple leaflet patterns.[2]

The mean annular circumference of the tricuspid valve in the present study was 10.25 cm. Kalyani et al. and Lama et al. reported comparable annular dimensions in cadaveric hearts.[8,9] Contemporary CT-based studies have demonstrated that annular geometry changes significantly in functional tricuspid regurgitation and plays an important role in transcatheter valve interventions.[10]

Among the tricuspid valve leaflets, the anterior leaflet showed the greatest annular length in the present study. Similar observations were reported by Preethi et al. and Kalyani et al., who described the anterior leaflet as the largest and most mobile leaflet.[8,11]

The mitral valve exhibited normal bicuspid morphology in 90% of specimens, whereas 10% demonstrated variations including monocuspid and tricuspid patterns. Similar anatomical variations were described by Gunnal et al. and Mishra et al.[12-15]

The mean annular circumference of the mitral valve in the present study was 9.1 cm, which correlated with findings from previous cadaveric studies by Gunnal et al. and Barry et al,[1,12] Barry et al. emphasized that accurate biometric measurements improve surgical repair outcomes and preserve posterior leaflet mobility.[1]

The posterior leaflet of the mitral valve demonstrated the greatest annular attachment length in the present study, whereas the anterior leaflet exhibited greater height. Similar observations were reported by Ranganathan et al. and Rustedetal.[14,15] Recent morphometric studies have also highlighted the importance of leaflet geometry and scalloping patterns in maintaining valvular competence.[4]

In the present study, the clear zone measurements were greater than rough zone measurements in most mitral and tricuspid valve leaflets. These findings are consistent with classical anatomical descriptions

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and are clinically significant because the rough zone serves as the area of chordal attachment and valve coaptation.[16]

The commissural measurements observed in the present study were comparable to findings reported in earlier cadaveric studies. Modern three-dimensional imaging studies have highlighted the importance of commissural anatomy during annuloplasty and transcatheter edge-to-edge repair procedures.[2,10]

The findings of the present study reinforce the importance of detailed anatomical knowledge of atrioventricular valves for surgeons, cardiologists and biomedical engineers. Variations in leaflet morphology, annular circumference, and commissural anatomy may influence surgical planning, prosthetic valve design and postoperative outcomes.[1,2]

CONCLUSION

The present cadaveric study demonstrated important variations in the morphology and morphometry of mitral and tricuspid valves.

Accessory cusps were more frequent in tricuspid valves, while the mitral valve predominantly showed bicuspid morphology.[6,12] The annular circumference of the tricuspid valve was greater than that of the mitral valve.[8,9]

Significant variations were observed in leaflet dimensions, commissural lengths and leaflet morphology. These findings are clinically important in valve repair surgeries, prosthetic valve sizing, transcatheter interventions and echocardiographic interpretation.[1,2]

Detailed anatomical understanding of atrioventricular valves is essential for successful surgical planning, prosthetic valve design and improved postoperative outcomes.[3,5]

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