Original Research Article

Tricuspid valve morphometry - In cadaveric study

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Abstract

Background: The tricuspid valve is situated between the right atrium and the right ventricle. This valve prevents back flow of blood from the right ventricle to right atrium. For cardiovascular surgeons, the morphometry of tricuspid valve is of clinical importance.
Aim: To study the tricuspid valve morphometry in cadavers.
Materials and methods: This study was conducted on 120 adult human hearts, whose age was ranging from 21 to 66 years, as decomposition or putrefaction might occur during medico-legal post-mortem examination which was performed within nineteen hours of death so that the morphology and morphometry of the heart was not altered. From the total number 30 hearts had accessory leaflets and scallops in tricuspid valve.
Results: : The weight of heart (g), circumference of tricuspid valve (mm), attachment length of leaflets and commissures (mm), height of three leaflets (mm) were the parameters which were studied. Between the circumference of tricuspid valve with the weight of heart, attachments lengths of leaflets and the three commissures and leaflets height, a direct correlation was observed.
Conclusion: This study can be used as an important tool in anthropological studies, which was performed to improve analysis of the morphometric parameters of tricuspid valve and to correlate the various parameters and which further helped the cardiac surgeons and forensic experts to understand the anatomy of the tricuspid valve complex and appropriate design of valvular complex for transplantation.

Key words

Tricuspid valve, Anteroseptal Commissure, Septo-posterior Commissure, Posteroanterior Commissure.

Introduction

The right atrio-ventricular valve is the largest of all the valves of the heart. The term atrio-ventricular valve apparatus or complex is more apt from a functional standpoint [1]. Tricuspid valve diseases are common in persons with pulmonary hypertension and intravenous drug abusers and may be congenital or acquired [2]. The most common anomaly of the tricuspid valve is the Ebstein's anamoly. The most common one in use is the trans-catheter therapies for mitral regurgitation. In rare cases, parallel percutaneous approaches for tricuspid regurgitation is needed. For differentiating between functional and organic tricuspid diseases, the knowledge of the morphology and morphometry of the tricuspid valve is needed accurately [3]. In human beings, the tricuspid valve does not lie in single line and its position and structural complexity adds to the challenges in its assessment by radiological techniques [4, 5]. To restore the original mechanics of the valvular complex in order to maintain the circulation naturally after repair of the diseased valve is the major task of cardio-surgeons. With interventional cardiology progressing rapidly, study of morphometric measures of tricuspid valve complex on cadavers is the important need of time.

Materials and methods

This study was conducted on 120 adult human hearts, whose age was ranging from 21 to 66 years, as decomposition or putrefaction might occur during medico-legal post-mortem examination which was performed within nineteen hours of death so that the morphology and morphometry of the heart is not altered. The hearts which are having evidence of any disease, decomposed or burnt, which are injured before or during autopsy were not included in the study. From the total 120 of hearts studied, 30 hearts had anatomical variation of one or more type in the leaflets structure and they were excluded. There were accessory leaflets and scallops in tricuspid valve in the 30 hearts. The hearts were placed back in the dead body after the desired parameters were studied. After cleaning the hearts under tap water, the hearts were dissected with least destruction of valves. The right atrium was opened, the first incision was given from right aspect of inferior vena cava and to the superior vena cava. Along the inferior border of the heart, the second incision was given to the inferior margin of anterior inter-ventricular groove along the acute margin of the heart. Right to the anterior interventricular groove, the third incision was made. Retraction of the walls carefully and the inferior was washed under tap water thoroughly to remove clots. Shape of the tricuspid valve was observed. At the junction of anterior and posterior leaflet, the tricuspid valve was opened by cutting the annulus. The heart was washed thoroughly. With a clean cloth, excessive water was soaked. Morphometric parameters measured are weight of heart, circumference of tricuspid valve, leaflets length, anterior leaflet, septal leaflet, posterior leaflet, attachment length of commissures. The weight of heart was recorded by using electronic weighing balance. The number of cusps of tricuspid valve and their position was noted. The lengths of all parameters were measured using non-strechable surgical silk thread. The thread was straightened and the length was measured by metric ruler with readability of 0.5 mm (**Figures – 1 to 4**). The results were computed and statistically analysed with SPSS software 16. P-value was calculated by Pearson's correlation coefficient and analysed as >0.05 was considered as statistically insignificant, <0.05 was considered as statistically significant, <0.01 was considered as statistically highly significant and <0.001 was considered as statistically extremely significant.

Results

Table - 1 shows that the morphometric parameters were calculated like average weight in grams was 259.87±33.74, the circumference in mm was 95.25±11.48, average attachment length in mm i.e. the septal leaflet was the largest amongst the three leaflets which was 29.44±5.77. Average of ASC, SPC and PAC was 7.54±4.53.

Figure - 1: Methods of Measurements of Circumference and attachment length of tricuspid valve leaflets with surgical Silk thread.

Figure - 2: Tricuspid Valve.

Figure - 3: Tricuspid Valve Complex.

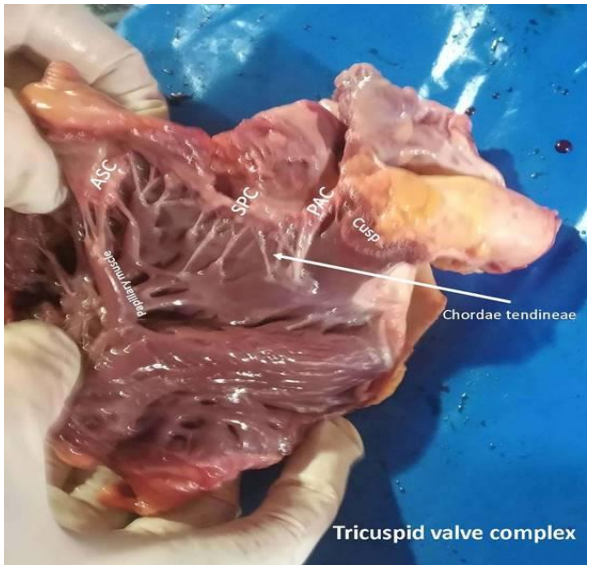

Figure - 4: Weighing machine used for the study.

Table - 2 shows that weight of heart and circumference of tricuspid valve was extremely significant with a p value of <0.001. Attachment length of anterior leaflet and circumference of tricuspid valve was insignificant with a p value of >0.05, attachment length of septal leaflet and circumference of tricuspid valve was extremely significant with a p value of <0.001, attachment length of posterior leaflet and circumference of tricuspid valve was extremely significant with a p value of <0.001.

Table - 3 shows that attachment length of ASC and circumference of tricuspid valve was highly significant with a p value of <0.01, attachment length of SPC and circumference of tricuspid valve was extremely significant with a p value of <0.001, attachment length of PAC and

circumference of tricuspid valve was highly significant with a p value of <0.01.

Table - 1: Morphometric parameters.

Sr. No	Morphometric parameters	
1.	Average Weight (gms)	259.87±33.74
2.	Circumference (mm)	95.25±11.48
3.	Ratio C/Wt	0.327±0.05
4.	Average attachment length (mm)	
a)	Anterior Leaflet	26.87±6.88
b)	Septal Leaflet	29.44±5.77
c)	Posterior Leaflet	23.07±9.21
d)	ASC	5.64±2.45
e)	SPC	9±3.67
f)	PAC	5.91±2.11
g)	Average (ASC+SPC+PAC)	7.54±4.53

ASC: Anteroseptal Commissure
SPC: Septo-posterior Commissure
PAC: Posteroanterior Commissure

Table - 2: Pearson's correlation coefficient between parameters and their p-value.

Morphometric parameters	Pearson's Correlation Coefficient	P-Value	significance
Weight of heart and Circumference of tricuspid	0.634	<0.001	Extremely significant
Attachment length of leaflet and Circumference of tricuspid valve			
Anterior Leaflet	0.1792	>0.05	Insignificant
Septal Leaflet	0.5218	<0.001	Extremely
Posterior Leaflet	0.479	<0.001	Extremely

Table - 4 shows that height of anterior leaflet and circumference of tricuspid valve was significant with a p value of <0.05, height of septal leaflet and circumference of tricuspid valve was insignificant with a p value of >0.05 and height of posterior leaflet and circumference of tricuspid valve was extremely significant with a p value of <0.001.

Table - 3: Pearson's correlation coefficient between parameters and their p-value.

Attachment length of commissure and Circumference of tricuspid valve			
ASC	0.415	<0.01	Highly significant
SPC	0.528	<0.001	Extremely significant
PAC	0.389	<0.01	Highly significant

Table - 4: Pearson's correlation coefficient between parameters and their p-value.

Height of leaflet and Circumference of tricuspid valve			
Anterior Leaflet	0.399	<0.05	Significant
Septal Leaflet	-0.038	>0.05	Insignificant
Posterior Leaflet	0.526	<0.001	Extremely significant

Discussion

Out of 120 hearts of present study, the anterior average attachment length of leaflet of tricuspid valve was 26.87±6.88 mm, the septal average attachment length of leaflet was 29.44±5.77 mm and the posterior average attachment length of leaflet was 23.07±9.21 mm, where as in Motabagani, et al. study [6], the anterior average attachment length of tricuspid valve leaflet was the highest with 43.60±3.40 mm, the septal average attachment length of leaflet was 33.20±3.30 mm and the posterior average attachment length of leaflet was 29.20±2.80. In Skwarek, et al. study [7], similar to the present study, the septal average attachment length of leaflet was the highest, the anterior average attachment length of leaflet was 31.98±8.74 mm, the septal average attachment length of leaflet was 32.16±8.79 mm and the posterior average attachment length of leaflet was 24.10±9.08. In

Antoniali, et al. study [8], the the septal average attachment length of leaflet was 30.6±3.7 mm. In the present study, average weight in grams was 259.87±33.74, the circumference in mm was 95.25±11.48 and C/wt ratio was 0.327±0.05mm, whereas in Skwarek, et al. [7] study, circumference was 105.67±16.76, in Antoniali, et al. [8] study, average weight in grams was 355.55±65.30, the circumference in mm was 105±12.7 and C/wt ratio was 0.303±0.05 mm. In present study, average of ASC, SPC and PAC was 7.54±4.53 whereas in Skwarek, et al. study [7], average of ASC, SPC and PAC was 6.42±2.23. In present study, ASC was 5.64±2.45 mm, SPC was 9±3.67 mm and PAC was 5.91±2.11 mm, whereas in Anwar, et al. [4, 5] study, ASC was 5.4±1.5 mm, SPC was 5.2±1.5 mm and PAC was 5.1±1.1 mm. In the present study, the height of anterior leaflet was 19.22±2.42 mm, the septal height of leaflet was 15.30±2.99 mm and the height of posterior leaflet was 16.22±2.88 mm, whereas in sSkwarek, et al. [7] study, the height of anterior leaflet was 23.88±0.85 mm, the septal height of leaflet was 18.33±0.98 mm and the height of posterior leaflet was 21.35±0.90 mm. The tricuspid annular diameter and dimensions of the valve orifice was closely correlated with age, body weight, height and body surface area but did not find correlation of parameters with the heart in Sairanen and Louhimo study [9] and Anwar, et al. [4, 5] study. However in the present study, a high significant correlation statistically was observed between weight of the heart, the attachment length of the leaflets, height of leaflets with the circumference of tricuspid valve. Kasliwal RR [10] reported that patients with structural heart disease (n=152) were evaluated by conventional two-dimensional transthoracic echocardiography and real-time three-dimensional transthoracic echocardiography using standard protocol. Fifty-six cases were of rheumatic etiology with multi-valvular involvement (mitral stenosis: 32; mitral regurgitation: 29; tricuspid regurgitation: 8; aortic valve disease: 11) and 21 cases of non-rheumatic valvular heart disease. A total of 38 congenital heart disease patients were examined including 23 patients with atrial septal defect. Left ventricular function (n=20) and right ventricular function (n=10) were also assessed using dedicated software.

Conclusion

This study can be used as an important tool in anthropological studies, which was performed to improve analysis of the morphometric parameters of tricuspid valve and to correlate the various parameters and which further helped the cardiac surgeons and forensic experts to understand the anatomy of the tricuspid valve complex and appropriate design of valvular complex for transplantation.

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