ORIGINAL ARTICLE

Morphometry of human tricuspid valve: A cadaveric study

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ABSTRACT

The cardiovascular system consists of a pump represented by the heart and blood vessels, which provide the route by which blood circulates to all parts of the body. William Harvey, in the 17th century, discovered that blood is pumped away from the heart, but it all returns to the heart after circulating in the body. A right ventricular function can be compromised by pressure or stress, often secondary to the right heart valve or muscle pathology. The valves maintain unidirectional flow and permit increased pressure to develop in the chambers. The tricuspid valve consists of three tissue flaps. It separates the right atria and the right ventricle. To measure morphometric measurements of an individual leaflet of the tricuspid valve of cadaveric human hearts. The material for the present study comprised of 50 formalin-fixed adult human hearts (35 males and 15 females) which were obtained from the Department of Anatomy from various medical colleges in Maharashtra. Statistical significant difference was found for the height of anterior and posterior leaflets between male and female hearts. The length of the septal leaflet was also found to be statistically significant between male and female hearts. The study will be helpful for cardiac surgeons in providing data for tricuspid valve complex, leaflets, cords and papillary muscles.

INTRODUCTION

The cardiovascular system consists of a pump represented by the heart and blood vessels, which provide the route by which blood circulates to and from all parts of the body. William Harvey in the 17th century discovered that blood is pumped away from the heart, but it all returns to the heart after circulating in the body (Harvey, 1928). Often ignored, but there is still scope of research for the right ventricle, particularly in the right ventricular failure. The RV is the most anterior structure of the heart, which lies underneath the lower sternum. It can be divided into three different regions, smooth muscular inflow containing the tricuspid valve and its apparatus, the outflow region and the trabeculated apical region (Jurcut et al., 2010). A right ventricular function can be compromised by pressure or stress, often secondary to the right heart valve or muscle pathology (Ho, 2006). The valves maintain unidirectional flow and permit increased pressure to develop in the chambers.

The tricuspid valve consists of three tissue flaps. It separates the right atria and the right ventri-
Table 1: Measurements of study parameters (male and female combined)

| Sr No. | Study Parameters | Mean   | Standard deviation |
|--------|------------------|--------|--------------------|
| 1      | Height of leaflet (H) in mm |        |                    |
| A      | Anterior         | 20.16  | 1.97               |
|        | Posterior        | 18.54  | 1.80               |
| C      | Septal           | 13.6   | 2.43               |
| 2      | Length of leaflet (L) in mm |        |                    |
| A      | Anterior         | 38.80  | 4.64               |
|        | Posterior        | 23.88  | 3.29               |
| C      | Septal           | 29.96  | 4.38               |

Anomalies of the tricuspid valve have been the target of several investigations. (Bisognano et al., 1998) described the congenital duplication of the human tricuspid valve with obstruction of the right ventricular outflow tract is determined by echocardiography to be a rare heart anomaly. Cardiac surgeons who are performing atrioventricular (tricuspid) valve repair instead of valve replacement, knowledge of detailed morphometry of these valves are necessary (Ratnatunga et al., 1998). With the invention of prosthetic valves used by cardiac surgeons to repair diseased or defective valves, specific understanding of the dimensions and size of the tricuspid valve would be of considerable benefit. After cardiac valve replacement, some patients may indicate little improvement in their clinical status, perhaps because their prosthesis is restrictive (Westaby et al., 1984). Paravalvular leakage (PVL) is an unexpected but severe potential issue with the implantation of a surgical prosthetic valve. Paravalvular leakage is the result of an inadequate connection between the sewing ring and the annulus (Kliger et al., 2013). It can result from excessive pressure or traction force on the prosthesis that occurs after surgery (Cicco et al., 2005), (Cicco et al., 2006).

Considering the clinical importance of the tricuspid valve, the present work is undertaken to explore the precise morphology and to carry out a morphometric study of the tricuspid atrioventricular complex, and normal quantitative values and range of dimensions of the tricuspid valve in healthy adult human hearts obtained by dissecting cadavers.

Figure 1: Showing three leaflets of the excised tricuspid valve

Aim and Objective

To measure morphometric measurements of an individual leaflet of the tricuspid valve of cadaveric human hearts

MATERIALS AND METHODS

The material for the present study comprised of 50 formalin-fixed adult human hearts (35 males and 15 females) which were obtained from the Department of Anatomy from various medical colleges in Maharashtra. The hearts with macroscopic developmental failures or pathological changes were eliminated from the study.

To open the right ventricle, a cut was taken from the opening of inferior vena cava and then along the right margin of the right ventricle. The tricuspid valve was cut between the anterior and posterior leaflets. The height of a leaflet was measured as it is the most significant distance between the basal and free margin of the leaflet. To measure the
Table 2: Study parameters showing statistical significance between male and female

|                          | Male       | Female     |
|--------------------------|------------|------------|
| Height of anterior leaflet (mm) | Mean: 20.57 SD: 1.91 | Mean: 19.2 SD: 1.82 |
| Height of posterior leaflet (mm) | Mean: 18.91 SD: 1.80 | Mean: 17.67 SD: 1.50 |
| Length of septal leaflet (mm) | Mean: 31.46 SD: 3.76 | Mean: 26.47 SD: 3.74 |

Table 3: Comparison between previous and present studies

| Height of Leaflets | Workers                                      |
|-------------------|----------------------------------------------|
|                   | (Skwarek et al., 2006) (107 formalin fixed hearts) | (Motabagani, 2006) (10 autopsy cases) | Present study (50 formalin fixed hearts) |
| A. Anterior       | 20.71±/-5.23                                 | 22.4±/-2.8                            | 20.16±/-1.97                             |
| B. Posterior      | 18.88±/-4.66                                 | 22.2±/-4.5                            | 18.54±/-1.80                            |
| C. Septal         | 17.22±/-4.71                                 | 15.5±/-1.5                            | 13.60±/-2.43                            |

Table 4: Comparison between previous and present studies

| Length of Leaflets | Workers                                      |
|-------------------|------------------------------------------------|
|                   | (Seccombe et al., 1993) (24 autopsy cases) | (Skwarek et al., 2006) (107 formalin fixed hearts) | (Motabagani, 2006) (10 autopsy cases) | Present study (50 formalin fixed hearts) |
| A. Anterior       | 38-42                                          | 31.98±/-8.74                             | 37.2±/-7.5                             | 38.80±/-4.64                            |
| B. Posterior      | 38-42                                          | 24.1±/-9.08                              | 26.3±/-4.7                             | 23.88±/-3.29                            |
| C. Septal         | 38-42                                          | 32.16±/-8.79                             | 31.3±/-3.6                             | 29.96±/-4.38                            |

length and height of particular leaflets, vernier caliper was used. The length of a leaflet was measured as the greatest distance between the intercuspal incisurae. The data obtained were statistically analysed for male and female hearts by using student’s t-test.

RESULTS AND DISCUSSION

The height (Motabagani, 2006) of anterior, posterior and septal leaflet was found to be (showed in photo1 and photo 2) 20.16±/-1.97 mm, 18.54+/1.80 mm and 13.6+/2.43 mm respectively. The mean value for the length of the anterior, posterior and septal leaflet was 38.80+/4.64 mm, 23.88+/3.29 mm and 29.96+/4.38 mm respectively. Table 1 Statistical significant difference was found for the height of anterior and posterior leaflets between male and female hearts. The length of the septal leaflet was also found to be statistically significant between male and female hearts. Table 2
and septal leaflet as 20.71+/−5.23 mm, 18.88+/−4.66 mm and 17.22+/−4.71 mm respectively. (Motabagani, 2006) examined ten hearts and found the height of anterior, posterior and septal leaflet as 22.4+/−2.8 mm, 22.2+/−4.5 mm and 15.5+/−1.5 mm respectively. In the present study, the height of anterior, posterior and septal leaflet is found to be 20.16+/−1.97 mm, 18.54+/−1.80 mm, and 13.60+/−2.43 mm, respectively. Table 3 In the previous and present study, it is observed that the anterior leaflet is having maximum height followed by posterior and then septal.

(Seccombe et al., 1993) examined 24 autopsy cases and observed that mean length were similar for anterior, posterior and septal leaflet as 38-42 mm. (Skwarek et al., 2006) examined 107 formalin-fixed hearts and observed the length of the anterior, posterior and septal leaflet as 31.98+/−8.74 mm, 24.1+/−9.08 mm and 32.16+/−8.79 mm, respectively. (Motabagani, 2006) observed the length of the anterior, posterior and septal leaflet as 37.2+/−7.5 mm, 26.3+/−4.7 mm and 31.3+/−3.6 mm respectively after examining ten hearts.

In the present study, the length of the anterior, posterior and septal leaflet is found to be 38.80+/−4.64 mm, 23.88+/−3.29 mm and 29.96+/−4.38 mm, respectively. The findings of the present study are consistent with the previous studies. In the earlier studies and the present study, the length of the anterior leaflet is more than the septal followed by posterior except the study by (Seccombe et al., 1993) which stated that mean length of all three leaflets were same. Table 4

CONCLUSIONS

The anatomy of the tricuspid valve complex is highly sophisticated. Still, an understanding of it is helpful in the practice of cardiac surgery, especially in the partial transfer of leaflets of the tricuspid valve for mitral valve repairs. Surgical repair of the mitral valve using tissue of the tricuspid valve is becoming ever more frequent as a result of the reduced rate of complications in comparison with repair using synthetic materials. Therefore the study will be helpful for cardiac surgeons in providing data for tricuspid valve complex, leaflets, cords and papillary muscles.

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Conflict of Interest

None.

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