Anatomic Consideration of Stitch Depth in Tricuspid Valve Annuloplasty

Yung-Tsai Lee, Chung-Yi Chang and Jeng Wei

**Background:** The durability of De Vega’s tricuspid valve annuloplasty might be related to tension of the annulus and could be reinforced by increasing stitch depth. However, depth of stitches to date has not been addressed in the literature. Thus, it is important to better understand the anatomical distance between the tricuspid valve annulus and the right coronary artery.

**Methods:** From 1998 to 2009, we measured the distances between TV annulus and RCA (TRD) on 46 explanted human hearts during heart transplantation. Five points were measured from the anterior/septal leaflet commissure to the posterior/septal leaflet commissure clockwise. Statistical significance was tested in the analyses.

**Results:** We found the TRD were independent from sex, age, body weight, and etiology. With a minimum of 10 mm at the posterior/septal leaflet commissure, the distances increased counterclockwise to the maximum of 20 mm at the anterior/septal leaflet commissure.

**Conclusions:** Stitch depth within 10 millimeter will not injure the right coronary artery in making De Vega’s tricuspid annuloplasty.

**Key Words:** De Vega’s tricuspid valve annuloplasty

**INTRODUCTION**

De Vega’s tricuspid valve annuloplasty is one of the conventional and reliable approaches for tricuspid valve (TV) repair. It is an easy and safe procedure, and mandatory in case of at least moderate functional tricuspid regurgitation (TR) to achieve better mid-term outcome in patients with functional mitral regurgitation undergoing mitral valve surgery. However, some clinicians have experienced a higher failure rate and prefer ring annuloplasty for the treatment of functional TR. Therefore, it is paramount to determine the best way to effectively perform De Vega’s tricuspid valve annuloplasty with adequate strength.

Failed De Vega’s tricuspid valve annuloplasty has been associated with the failure to reduce the tension of tricuspid annulus, progression of tricuspid valve disease, and injury to the right coronary artery (RCA). Adequate stitch depth into the TV annulus is essential to maintain the strength of the annuloplasty that corrects the regurgitation. However, the stitch depth and the surrounding anatomy were never addressed in the original article. Therefore, we would like to measure the TV annulus and RCA to more effectively guide De Vega’s tricuspid valve annuloplasty procedure.

**MATERIALS AND METHODS**

Arising from those human hearts obtained in recipient cardiectomy, the distances between TV annulus and RCA (TRD) were measured at five locations separated equally clockwise from the anterior/septal leaflets
commissure to the posterior/septal leaflets commissure, as marked points a, b, c, d, and e (Figure 1). Each of the subject’s sex, age, body weight, and diagnosis were also recorded.

Descriptive statistics such as means and standard deviations were tabulated, for overall and strata such as diagnosis and sex, as well as the bar graph of the TRD at different points. The difference among age, sex and etiology were compared; the distances of different locations a, b, c, d, and e were also compared.

For two-group comparison, the Mann-Whitney U test was utilized; for correlation, Spearman’s method was used. For multi-group comparison, the Kruskal-Wallis test and ANOVA were used, with post-hoc multiple comparison tests by Bonferroni, Scheffe, and Sidak to identify which two groups differed. Stata 11.0 (http://www.stata.com) was used for the aforementioned statistical analyses.

RESULTS

From April 1998 to November 2009, we measured the TRD on 46 explanted human hearts. The subjects presented a male to female ratio of 35/11, median age of 53 years (range: 13 to 68), and median body weight of 56.5 kg (range: 10 to 96). The TRD at the locations of points a, b, c, d, and e were not different among patients with the diagnosis of dilated cardiomyopathy (DCM), ischemic cardiomyopathy (ICM), and hypertrophic cardiomyopathy (HCM) (for points a, b, c, d, and e, p = 0.30, 0.55, 0.13, 0.33, and 0.26, respectively). The TRD at the locations of points a, b, c, d, and e did not have significant correlation with age (for points a, b, c, d, and e, p = 0.55, 0.28, 0.40, 0.63, and 0.79, respectively) or with body weight (for points a, b, c, d, and e, p = 0.31, 0.76, 0.98, 0.82, and 0.35, respectively).

The TRD differed at the different locations of points a, b, c, d, and e (p < 0.0001). By post hoc tests, the distances differed for the points of a vs. b, a vs. c, a vs. d, a vs. e, b vs. d, b vs. e, and c vs. d (all with p < 0.001). In brief, the TRD was the longest at the point a (anterior/septal leaflet commissure), and then decreased significantly clockwise to point e (posterior/septal leaflet commissure). The descriptive statistics of TRD were summarized in Table 1 and Figure 1.

DISCUSSION

The most common tricuspid valve disease etiology in North America is TR secondary to left heart patho-

<table>
<thead>
<tr>
<th>Location</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>95% CI</th>
<th>Median</th>
<th>IQR</th>
<th>25%~75% percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>46</td>
<td>20.22</td>
<td>3.80</td>
<td>0.56</td>
<td>19.12</td>
<td>21.32</td>
<td>4</td>
<td>18 22</td>
</tr>
<tr>
<td>b</td>
<td>46</td>
<td>15.09</td>
<td>3.92</td>
<td>0.58</td>
<td>13.95</td>
<td>16.22</td>
<td>6</td>
<td>12 18</td>
</tr>
<tr>
<td>c</td>
<td>46</td>
<td>13.91</td>
<td>4.30</td>
<td>0.63</td>
<td>12.67</td>
<td>15.16</td>
<td>5</td>
<td>10 15</td>
</tr>
<tr>
<td>d</td>
<td>46</td>
<td>10.35</td>
<td>3.55</td>
<td>0.52</td>
<td>9.32</td>
<td>11.37</td>
<td>4</td>
<td>8 12</td>
</tr>
<tr>
<td>e</td>
<td>46</td>
<td>11.74</td>
<td>4.40</td>
<td>0.65</td>
<td>10.47</td>
<td>13.01</td>
<td>6</td>
<td>9 15</td>
</tr>
</tbody>
</table>

CI, confidence interval; IQR, interquartile range; SD, standard deviation; SE, standard error.
ology, such as mitral valve disease and left heart failure.\textsuperscript{7,8} Functional TR can usually be corrected with TV repair, which is associated with lower peri-operative risk than TV replacement. There are essentially two kinds of TR repair: De Vega’s tricuspid valve annuloplasty and ring annuloplasty. Of the two, De Vega’s tricuspid valve annuloplasty is simpler and time saving. However, De Vega’s tricuspid valve annuloplasty is considered to be associated with a higher failure rate than ringed annuloplasty.\textsuperscript{3} Freedom from TV reoperation 10 years after repair with a De Vega’s tricuspid valve annuloplasty was 87.9\% compared with 98.4\% after ring annuloplasty.\textsuperscript{9} Failure of De Vega’s tricuspid valve annuloplasty was related to failure to reduce the tension of tricuspid annulus,\textsuperscript{5} progression of tricuspid valve disease\textsuperscript{6,7} and injury to the RCA.\textsuperscript{4} This is the first attempt to describe the relationship between the right coronary artery and tricuspid annulus. The measurement showed the minimum of 10 mm at the posterior/septal leaflet commissure and the maximum of 20 mm at the anterior/septal leaflet commissure. During one reoperation of recurrent tricuspid regurgitation in the center, we found exposed stitches that cut through the annulus. This finding hinted of the fact that the deeper bite of stitches warrants a successful De Vega’s tricuspid valve annuloplasty. Therefore, a deep-bite stitch could enforce the annulus and the TRD could provide information about the annulus related to RCA and tissue thickness.

Our results had shown that the TRD increased from the minimal 10 mm at the posterior/septal leaflet commissure to the maximal 20 mm at the anterior/septal leaflet commissure counterclockwise. They were independent from sex, age, body weight, or diagnosis. The measurements could definitely help us to make the De Vega’s tricuspid valve annuloplasty with more confidence while avoiding the injury to RCA.

CONCLUSIONS

Stitch depth within 10 mm will not injure the right coronary artery as part of the process of undertaking De Vega’s tricuspid valve annuloplasty. Such findings will be beneficial for medical care professionals as they make an optimal De Vega’s tricuspid valve annuloplasty.

ACKNOWLEDGEMENT

We thank Dr. Rober JC Chen for his review and suggestions of statistical methods.

REFERENCES

6. De Vega NG. Yesterday’s future: the gap between where we are now and where we were supposed to be. Eur J Cardiothorac Surg 2013;43:66.