Is a tricuspid annuloplasty ring significantly better than a De Vega’s annuloplasty stitch when repairing severe tricuspid regurgitation?

Maziar Khorsandi, Amit Banerjee, Harpreet Singh and Aseem R. Srivastava

Abstract

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was whether tricuspid valve (TV) repair with an annuloplasty ring leads to an improved outcome over a conventional suture annuloplasty for patients with severe tricuspid incompetence. Altogether, 306 papers were found using the reported search, of which 14 presented the best evidence to answer the clinical question. The author, journal, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these papers are tabulated. We found seven studies supporting the use of ring annuloplasty over De Vega’s suture annuloplasty. Five studies found no significant difference in outcome between the two techniques. We found only two studies supporting the use of De Vega’s suture repair over ring annuloplasty. Therefore, most of the tabulated studies show good evidence in support of ring annuloplasty compared with De Vega’s suture repair for treatment of moderate to severe TV regurgitation. One cohort study identified a 20.4% postoperative failure rate for tricuspid regurgitation (TR) repair and concluded non-application of ring as a predictor for reoperation. One cohort study with a mean follow-up of 17 months reported success rates as high as 97% with ring annuloplasty for TV regurgitation. One large cohort study of 2277 patients with TR who had undergone repair reported a sustained reduction in TR and the rate of recurrence in a 5-year echocardiographic follow-up. One cohort study of 129 patients concluded that ring annuloplasty has the lowest rate of recurrence compared with De Vega’s suture repair. An old randomized controlled trial (RCT) on the subject also reported a similar result to the mentioned studies. In contrast, we reviewed one recent study and four older studies and found no significant difference between the two techniques. We reviewed one study that reported De Vega’s suture repair as a superior technique to ring annuloplasty. We conclude that there is good evidence supporting ring annuloplasty over conventional De Vega’s suture annuloplasty.

Keywords: Tricuspid valve • Suture • Cardiac valve annuloplasty

INTRODUCTION

A best evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

CLINICAL SCENARIO

You are planning mitral valve repair on a 35-year old patient with severe mitral incompetence. He also has severe tricuspid regurgitation (TR) on echocardiography. It is your usual practice to perform a De Vega’s suture tricuspid annuloplasty under these circumstances. However, a colleague tells you that, in his experience, people have now mostly moved away from suture annuloplasty towards commercially available annuloplasty rings as they are better. You decide to check the literature before switching to the more expensive option.

THREE-PART QUESTION

In [patients with severe tricuspid incompetence] does [repair with an annuloplasty ring] compared with [De Vega’s annuloplasty suture] improve [tricuspid valve competence].

SEARCH STRATEGY

Medline was searched from 1948 to November week 1, 2011, using the OVIDSP interface (tricuspid valve$ AND exp Cardiac Valve Annuloplasty/).
Table 1: Summary of best evidence papers

<table>
<thead>
<tr>
<th>Author, date and country, Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
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<tbody>
<tr>
<td>Bernal et al. (2010), Circulation, Spain (level 3)</td>
<td>153 consecutive patients underwent TV repair for rheumatic valvular disease. The repair techniques included flexible ring annuloplasty in 68 (44%), suture annuloplasty in 20 (13.1%) combined with tricuspid commissurotomy in 62 (42.5%)</td>
<td>Rate of reoperation De Vega’s suture repair vs. ring annuloplasty</td>
<td>63 (40%) of patients required reoperation. Reoperation was associated significantly with the method of valve repair</td>
<td>The number of subjects is a limiting factor for this study. This study focuses on rheumatic valvular disease, the incidence of which is very few in the western world nowadays</td>
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<tr>
<td>Giamberti et al. (2011), J Heart Valve Surg, Italy (level 3)</td>
<td>Total of 65 patients underwent TV repair for TR between 2000 and 2008. TR was repaired using suture annuloplasty (n = 48), valve ring (n = 14) and TV replacement (n = 3)</td>
<td>Comparison of outcome between De Vega’s annuloplasty and ring repair for TR at 5 years of follow-up</td>
<td>No significant difference seen in the outcome between annuloplasty and ring repair for TR</td>
<td>The study is a retrospective one. The number of subjects studied was too few for the outcome to be significant. In particular, the number of patients undergoing ring repair was much fewer than the patients undergoing De Vega’s annuloplasty</td>
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<td>Tang et al. (2006), Circulation, Canada (level 3)</td>
<td>1978–2003, 702 consecutive patients undergoing TV repair. Annuloplasty ring applied in 209 patients and 493 had De Vega’s annuloplasty</td>
<td>Perioperative events</td>
<td>Higher incidence of low cardiac output in patients receiving a ring (P = 0.001). However, similar incidence of perioperative deaths, myocardial infarction, bleeding, stroke and endocarditis</td>
<td>Significantly more patients in the no ring group had prior cardiac surgery (P = 0.001), coronary artery disease (P = 0.03) and endocarditis (P = 0.04). Also the mean age differed significantly between the groups (P = 0.001); these could account for poorer survival in the no ring group</td>
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Survival

Better long-term (P = 0.007) and event-free (P = 0.01) survival in patients receiving a ring

Recurrent TR

Lower TR recurrence rate in patients receiving a ring

New York Heart Association (NYHA) class

NYHA class III/IV symptoms were reported in 20% of patients that underwent ring annuloplasty vs. 25% in patients who underwent suture annuloplasty

Events registered for event-free survival thromboembolism, valve thromboembolism, structural valve dysfunction, bleeding event and endocarditis—these relate to prosthetic valves replaced concomitantly (80% mitral, 33% aortic) and not to TV repair per se. Only TV reoperation and valve-related mortality directly addresses the issue, none was significantly different between the groups

Cross clamp time was significantly higher (P = 0.049) in the ring group, cardiopulmonary bypass (CPB) time was similar (even though
Table 1: (Continued)

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<td>McCarthy et al. (2004), J Thorac Cardiovasc Surg, USA [5]</td>
<td>Between January 1990 and January 1999, 790 patients underwent annuloplasty for functional TR. 139 (17%) with Carpentier–Edwards semi-rigid ring, 291 (37%) with Cosgrove–Edwards flexible band, 116 (15%) De Vega and 243 (31%) Peri-Guard Follow-up every 2 years and then cross-sectional in the year 2000</td>
<td>Durability of repair</td>
<td>At 1 month, prevalence of 3+ or 4+ TR similar among all groups (15% Carpentier–Edwards semi-rigid ring, 15% with Cosgrove–Edwards band, 14% De Vega and 15% for Peri-Guard)</td>
<td>Late worsening of TR is associated not only with patient factors but also by the type of annuloplasty. De Vega’s and Peri-Guard annuloplasty showed considerable late worsening of TR</td>
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| Rivera et al. (1985), J Thorac Cardiovasc Surg, Spain [6] | Between January 1977 and January 1980, 159 patients with moderate to severe TR were randomized to one of the two groups: Carpentier’s (n = 76) and De Vega’s (n = 83) tricuspid annuloplasty Average follow-up was 65 months (range, 48–85 months) 76 patients underwent cardiac catheterization | In-hospital/late deaths Reoperations Clinical status at follow-up Angiographic incidence of TR on follow-up | Similar incidence of early and late deaths between the two groups Similar rates of reoperation In patients who did not have a reoperation and who had no left heart lesion on cardiac catheterization—the incidence of murmur of TR and clinical signs of right heart failure were higher in patients that had undergone De Vega’s annuloplasty as compared to patients that received a ring annuloplasty (14 of 41 and 4 of 40, respectively, P < 0.01) In patients with peripheral vascular resistance (PVR) < 1000 dynes/s/cm², moderate the no-ring group had significantly higher redo patients and more patients undergoing concomitant coronary artery bypass grafting). This is important as significantly higher percentage of patients undergoing ring annuloplasty suffered low cardiac output | Carpentier’s ring annuloplasty is more efficacious in controlling TR in patients with satisfactory left heart function A good randomized study that provides reliable evidences in favour of ring annuloplasty In patients with raised PVR and left heart lesions, the outcome of both techniques is equally unsatisfactory Since this is an old study, echocardiography was not utilized in the assessment of any patient. 26 (16%) of the patients were assessed on clinical grounds alone and 9 (5.7%) by digital exploration by the surgeon before bypass. The

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<td>Ghoreishi et al. (2011), Ann Thorac Surg, USA [9]</td>
<td>101 patients between 2006 and 2009 underwent TV repair for moderate or severe TR: 88% of these patients had their TR treated with three-dimensional rigid annuloplasty ring</td>
<td>Efficacy of rigid, three-dimensional annuloplasty ring in the treatment of functional TR</td>
<td>To severe TR was lower in patients who underwent Carpentier’s ring annuloplasty compared with De Vega’s annuloplasty (1 of 19 and 9 of 19, respectively, P &lt; 0.01)</td>
<td>Remaining 124 (78%) patients were assessed by ventriculography</td>
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<td>Navia et al. (2010), J Thorac Cardiovasc Surg, USA [10]</td>
<td>2277 patients underwent TV repair for TR. The surgical methods utilized included: 1636 (71%) of the patients underwent ring annuloplasty. 129 (5.1%) underwent De Vega’s suture annuloplasty. 185 (8.1%) patients underwent Peri-Guard annuloplasty</td>
<td>Comparison of efficacy of ring annuloplasty vs. De Vega’s annuloplasty</td>
<td>On 5-year follow-up, patients with ring annuloplasty alone had the least rate of TR compared with the other surgical techniques</td>
<td>This was a large retrospective cohort study. However, the number of subjects included in each surgical technique was very variable for the comparison to be based on objective analysis e.g. 71% of patients had ring annuloplasty, whereas only 5.1% had undergone De Vega’s suture repair</td>
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<td>Sarralde et al. (2010), Ann Thorac Surg, Spain [11]</td>
<td>299 patients underwent TV repair between 1974 and 2007 for severe rheumatic valvar disease. Prosthetic ring annuloplasty was performed in 78 (26%) patients, commissurotomy and ring annuloplasty in 82 (27%), isolated commissurotomy in 10 (4%), suture annuloplasty in 105 (35%) and commissurotomy and suture annuloplasty in 24 (8%)</td>
<td>The use of age, NYHA functional class and postclamping time were assessed as predictive factors for late mortality</td>
<td>The study found a reduced rate of late mortality in the patient group who underwent De Vega’s suture repair of the TV, compared with ring annuloplasty</td>
<td>The study is of value due to long follow-up. Nevertheless, although the mean follow-up was 16 years, some patients had had their procedures over 30 years prior to the date of publication. It was acknowledged that there had been a change in population as well as change in the operative techniques over the years which could be confounders affecting the study result</td>
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<td>Basel et al. (2010), Heart Surg Forum, Turkey [12]</td>
<td>129 patients underwent annuloplasty to correct TV regurgitation between 2004 and 2008. The patients in this study were divided into two groups. Group 1 was the patients who had undergone ring annuloplasty (n = 67) and Group 2 had undergone De Vega’s suture repair (n = 62)</td>
<td>Complication and recurrence rates of ring annuloplasty vs. De Vega’s suture repair</td>
<td>Both groups had low complication and recurrence rates. However, patients in Group 1 had lower recurrence rates than those in Group 2</td>
<td>The number of patients is the limiting factor for this study</td>
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<td>Matsuyama et al. (2001), J Heart Valve Dis, Japan [13]</td>
<td>Between January 1995 and July 2000, 45 patients who had undergone surgery for secondary TR were reviewed; 28 (62%) had undergone De TR recurrence in each group</td>
<td>Significant difference in TR recurrence: 45% (13 of 28) in De Vega’s and 6% (1 of 16) in Carpenter-Edwards ring annuloplasty</td>
<td>CE ring annuloplasty is superior to De Vega’s annuloplasty in patients with secondary TR</td>
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<td>Retrospective cohort study (level 3)</td>
<td>Vega’s annuloplasty and 17 (38%) had undergone CE ring annuloplasty</td>
<td>NYHA class between the two groups</td>
<td>No significant difference in the NYHA class</td>
<td>The sample size was too small in this study</td>
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<td>Chang et al. (2008), Ann Thorac Surg, South Korea [14]</td>
<td>334 patients underwent tricuspid annuloplasty for functional TR between 1997 and 2006. De Vega’s suture annuloplasty was performed in 117 and autologous pericardial strip annuloplasty was performed in 217 patients</td>
<td>Postoperative significant TR</td>
<td>34 (11.1%) of patients had significant TR on discharge from the hospital. The study reported that TR improved in the patient group who had pericardial strip. However, it worsened in the group with De Vega’s suture repair ($P = 0.05$)</td>
<td>The number of subjects is a limiting factor. The study</td>
</tr>
<tr>
<td>Retrospective cohort study (level 3)</td>
<td>Mean follow-up was 3.5 years</td>
<td>TR recurrence rate</td>
<td>De Vega’s vs. Pericardial strip annuloplasty</td>
<td>Recurrence-free survival was better with pericardial strip annuloplasty compared with that of De Vega’s suture repair (86.8 and 71.9%, respectively ($P = 0.039$))</td>
</tr>
<tr>
<td>Ghanta et al. (2007), J Thorac Cardiovasc Surg, Boston [15]</td>
<td>January 1999 to December 2003, 237 patients underwent tricuspid annuloplasty. Suture bicuspidization was performed in 157 (66%) and ring annuloplasty in 80 (34%)</td>
<td>CPB and aortic cross-clamp time</td>
<td>CPB and cross-clamp time were shorter by 27 min ($P = 0.02$) and 17 min ($P = 0.07$), respectively, in bicuspidization patients</td>
<td>Both bicuspidization and ring annuloplasty produce an effective, durable repair at 3 years. postoperatively</td>
</tr>
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<td>Retrospective cohort study (level 3)</td>
<td>Mean follow-up was 3 years</td>
<td>Mortality</td>
<td>Insignificant difference in early and late mortality between the two groups at 3 years follow-up</td>
<td>Mean follow-up was short Median time of echocardiographic assessment was 1 year (Q1, 1 week; Q3, 1.5 years). This renders the meaningful follow-up for the assessment of recurrent TR even shorter</td>
</tr>
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<td>Carrier et al. (2004), J Heart Valve Dis, Canada [16]</td>
<td>Between 1976 and 2002, 463 patients underwent 478 tricuspid annuloplasty procedures. 107 patients (23%) underwent De Vega’s semi-circular annuloplasty, 267 (58%) underwent the Bex flexible linear reducer and 89 (19%) Carpenter–Edwards ring annuloplasty</td>
<td>Survival</td>
<td>Survival at 5 years was similar between De Vega’s and Carpenter–Edwards ring annuloplasty (82 ± 4 and 88 ± 4%, respectively)</td>
<td>All three techniques resulted in a low rate of failure and good patient survival</td>
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<td>Prospective cohort study (level 3)</td>
<td>Repair failure</td>
<td>Freedom from repair failure was also similar between De Vega’s and Carpenter–Edwards ring annuloplasty (95 ± 3 and 94 ± 3%, respectively)</td>
<td>Freedom from repair failure</td>
<td></td>
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<tr>
<td>Morishita et al. (2002), J Cardiovasc Surg, Japan [17]</td>
<td>408 patients underwent De Vega’s tricuspid annuloplasty for TR between 1980 and 1999</td>
<td>De Vega’s annuloplasty long-term outcome</td>
<td>The 15-year freedom rate from reoperation was 91.6%. The study concluded that De Vega’s annuloplasty was an effective and reliable procedure for the treatment of TR</td>
<td>Lack of the comparison group was a major limiting factor. However, the study highlights that De Vega’s annuloplasty is a relatively cheap and reliable technique</td>
</tr>
<tr>
<td>Retrospective cohort study (level 3)</td>
<td>Mean follow-up was 15 years</td>
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mp.) AND (thoracic surgery.mp. or exp Thoracic Surgery/OR exp Cardiac Surgical Procedures/OR valve surgery.mp.).

SEARCH OUTCOME

Three hundred and six papers were identified from the search strategy from which 14 represented the best evidence on this topic and are summarized in Table 1.

RESULTS

Moderate and severe TR is associated with poor short- and long-term survival [2].

In the past few years, the treatment options for TR have ranged from conservative management to valve replacement and repair. However, recently, the management of TR has evolved in many ways shoulder to shoulder with the management of mitral incompetence, that is, from plication to suture-based annuloplasty to valve replacements and finally to state of the art ring-based repairs. Ring-based repairs are advantageous compared with the other mentioned techniques, since, theoretically, the artificial ring takes tension away from the suture line and prevents recurrent dilatation [3]. Hence, many studies now suggest an improved outcome with ring-based repairs over the conventional suture tricuspid annuloplasty [3–7].

It is well known that residual TR after surgical repair can lead to biventricular failure, death or reoperation [8], and therefore, the choice of repair is dictated predominantly by the recurrence rate of the procedure. The reported recurrence rates with De Vega’s annuloplasty appear to be higher compared with ring repair [2, 4–6, 9–12]. However, the only available randomized control trial on this issue is almost two decades old, when diagnosis of TR and its severity, both preoperatively and after, was on clinical grounds [13].

Studies supporting ring annuloplasty as a treatment of choice for TR

Bernal et al. [2] performed a retrospective cohort study with a 15-year follow-up. One hundred and fifty-three patients had undergone combined tricuspid and mitral valve repair surgery. Thirty-eight (20.4%) patients required reoperation for tricuspid valve (TV) dysfunction. The lack of application of an artificial ring was identified as a predictor for reoperation in this study. Ghoreishi et al. [9] performed a prospective cohort study of 101 consecutive patients who had undergone TV repair for TR with an annuloplasty ring. Freedom from more than moderate TR post-ring annuloplasty on discharge was as high as 97%. In a larger study, Navia et al. [10] studied a cohort of 2277 patients who had undergone TV procedures for TR. By the 5-year follow-up with transthoracic echocardiography, the patients who had undergone ring annuloplasty had the least TR recurrence compared with other techniques.

Basel et al. [12] performed a study of 129 patients undergoing annuloplasty for TR. Of this group, 67 had undergone ring annuloplasty and the remaining 62 patients had undergone De Vega’s annuloplasty. The study concluded that ring annuloplasty has a significantly lower TR recurrent rate.

In our literature search, we only found one randomized controlled trial (RCT) with regard to the subject. This was performed by Rivera et al. [6] in 1985. One hundred and fifty-nine patients who had undergone TV repair for moderate to severe TR had been randomized, of which 76 patients had undergone ring annuloplasty and 83 De Vega’s suture repair. The study concluded on the 5-year follow-up that the rate of TR was significantly higher with De Vega’s suture repair compared with ring annuloplasty.

Matsuyama et al. [13] and Chang et al. [14] both also supported the above findings. However, the latter study compared pericardial strip annuloplasty with De Vega’s suture annuloplasty.

Studies not supporting ring annuloplasty as treatment of choice for TR

Giamberti et al. [3], in a cohort of 65 patients who had undergone TR repair using suture annuloplasty (n = 48) and TV ring (n = 14), reported no significant difference in outcome between the two techniques on a 5-year follow-up. Moreover, Sarralde et al. [11] performed a retrospective cohort study of 299 patients who had undergone TV repair with a mean follow-up of 16.4 years. This study reported better results with the conventional De Vega’s suture annuloplasty compared with ring annuloplasty.

Tang et al. [3], Ghanta et al. [15], McCarthy et al. [5] and Carrier et al. [16] found no statistically significant difference between the two techniques of ring annuloplasty and De Vega’s annuloplasty.

Morishita et al. [17] reported in their cohort of 408 patients undergoing De Vega’s annuloplasty that this is a safe and effective method of TR repair.

An important shortcoming central to almost all reported series is a non-standardized selection criterion for the repair technique that was based solely on the surgeon’s discretion. This bias can only be overcome by a randomized trial, and it is unfortunate that none relevant to the current era is available.

A higher incidence of low cardiac output has been reported with ring annuloplasty [4]. We presume that this may arise as a consequence of a longer aortic cross-clamp time [3, 4] and bypass time [3–5]. In addition, a ring-based TV repair may be rendered less desirable by the relative inexpensiveness of a suture annuloplasty.

CLINICAL BOTTOM LINE

We conclude that there is good evidence to support ring annuloplasty over De Vega’s annuloplasty. Multiple recent cohort studies support the use of ring annuloplasty for moderate to severe TR over De Vega’s annuloplasty both in terms of the rate of recurrence of TR leading to reoperation and long-term mortality.

Conflict of interest: none declared.

REFERENCES


