Effect of annulus dimension and annuloplasty on bicuspid aortic valve repair

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Abstract

OBJECTIVES: We have recently shown that valve sparing reimplantation (VSR) improves the durability of bicuspid aortic valve repair in comparison with subcommissural annuloplasty. The aim of this study was to assess the degree of annular reduction provided by these techniques and to correlate these findings with repair durability.

METHODS: From 1995 to 2010, 161 patients underwent bicuspid valve repair. We included only patients with subcommissural annuloplasty or reimplantation having intraoperative pre- and post-repair transoesophageal echocardiography images. Pre- and post-repair ventriculo-aortic junction (VAJ) diameters were measured on long axis views. Inclusion criteria were met by 53 patients with subcommissural annuloplasty and 65 with reimplantation. Median follow-up was 53 months in the subcommissural annuloplasty group and 42 months in the reimplantation group. Follow-up completeness was 100% in subcommissural annuloplasty and 94% in reimplantation.

RESULTS: There was no operative or late mortality. Mean preoperative VAJ was similar in both groups (reimplantation: $28 \pm 3$ mm vs subcommissural annuloplasty: $28 \pm 3$ mm; $P = 0.16$). Preoperative VAJ was larger in patients <40 years and with aortic regurgitation (AR) ≥3+ ($P < 0.01$). Mean postoperative VAJ was smaller in reimplantation compared with subcommissural annuloplasty ($21 \pm 2$ mm vs $24 \pm 3$ mm; $P < 0.01$). In univariate analyses, subcommissural annuloplasty, preoperative VAJ ≥30 mm, postoperative VAJ ≥25 mm and cusp repair with patch were predictive of recurrent AR > 1+. In the subcommissural annuloplasty group, VAJ ≥30 mm preoperatively and ≥25 mm postoperatively were associated with decreased 6 years freedom from recurrent AR > 1+ (≤30 mm: 74% vs ≥30 mm: 39%, $P = 0.01$; <25 mm: 80% vs ≥25 mm: 31%, $P = 0.02$). In the reimplantation group, VAJ dimension had no effect on recurrent AR > 1+ ($P = 0.93$).

CONCLUSIONS: In bicuspid aortic valve repair, the circumferential annuloplasty of VSR offers greater reduction of VAJ compared with the non-circumferential annuloplasty provided by the subcommissural annuloplasty. The degree and extent of VAJ reduction in reimplantation seem to be factors among others that positively influence repair durability particularly in patients with a large VAJ (≥30 mm).

Keywords: Bicuspid aortic valve • Aortic valve repair • Aortic root aneurysm • Valve regurgitation • Valve sparing surgery

INTRODUCTION

Bicuspid aortic valve (BAV) repair for aortic regurgitation (AR) and or aortic aneurysm is an attractive alternative to prosthetic valve replacement in the adolescent and young adult [1–4]. However, most studies report a reoperation rate of 20% or more after one decade mainly due to recurrence of AR [2, 4–6]. In a recent work, we have shown that the rate of reoperation and recurrent AR can be significantly reduced in patients having BAV repair when the valve sparing reimplantation (VSR) technique is used rather than the subcommissural annuloplasty technique (SCA) or no annuloplasty [7]. After SCA, we have also observed recurrent dilatation of the ventriculo-aortic junction (VAJ) in patients needing reoperation [7]. Moreover, it is known that the VAJ enlargement is correlated with the degree of AR [8, 9]. In BAV repair, large VAJ has already showed to be a risk factor for repair failure [6]. Therefore, we hypothesize that the durability benefit conferred by the VSR on BAV repair is related, along with other factors, to the degree and extent of annuloplasty provided by this technique. The prosthesis-based circumferential annuloplasty of the VSR procedure potentially offers greater reduction and stabilization over time of the VAJ compared with the non-circumferential annuloplasty provided by the SCA.
The aim of the present study was to evaluate the effect of the SCA and the VSR on VAJ dimensions and to evaluate the impact of pre- and postoperative VAJ dimensions on the mid to long-term outcomes after BAV repair.

MATERIALS AND METHODS

Patient population

Data for this study were extracted from the institutional database of AV repair and the database of echocardiographic images. The surgical database identified 161 patients having BAV repair from 1995 to 2010. Of them, 71 have had SCA (ascending aorta replacement or root remodeling), 74 have had VSR and 16 have had no VAJ annuloplasty (cusp repair, ± ascending aorta replacement or root remodeling). Of the 145 patient having SCA or VSR, we found 118 patients (SCA n = 53, VSR n = 65) with analyzable pre- and post-repair echocardiographic images and they represent the study cohort. Because echocardiographic studies were stored inconsistently before the year 2001, only 2 patients included in this cohort were operated on prior to this year, one in 1998 and one in 2000. Prospectively collected, periprocedural data were retrospectively reviewed. Clinical and echocardiographic follow-up were updated every 2 years by a dedicated research nurse. The study was approved by the ethics review board of the hospital.

Surgical techniques

The surgical techniques of AV repair and the specific approach in BAV have been extensively described in previous works [5, 7]. Over the study period, our approach of functional aortic annulus (i.e. aortoventricular and sinotubular junction) stabilization has become more aggressive, resulting in recent years in a liberal use of root replacement with VSR. In our early experience, patients without root aneurysm generally received SCA, with or without ascending aorta replacement in case of associated aneurysm. In cases of root aneurysm, patients often had root remodeling. However, after the year 2000, we increasingly started using the VSR technique. Later in our experience, we expanded the indication of VSR to patients with moderate root dilatation and sometimes even no root dilatation, but a large annular diameter, essentially to improve stabilization of the VAJ.

The SCA, adapted from the aortic annuloplasty described by Cabrol in the sixties [10], was performed using a Teflon reinforced braided sutures. The ‘U’ shaped stitch was passed horizontally, through the aortic wall from one to the other side of the commissure; one stitch was placed at each commissure of the valve. The annuloplasty was generally performed in the middle third of interleaflet triangle height or lower to obtain greater plication effect.

Our technique of VSR has been described elsewhere [5, 11]. Briefly, before 2009, the graft was sized by adding 4-5 mm to the sinotubular junction size that corresponded with optimal cusp coaptation. The GelweaveValsalva™ graft (Vascutek Ltd, a Terumo company, Renfrewshire, Scotland graft) was progressively introduced since its availability on the market in 2002. For the past 3 years, the Valsalva™ graft has been nearly systematically used for VSR and the size was given by the measure of non-left commissure height as previously described [12].

Echocardiographic measure of pre- and post-repair ventriculoaortic junction

All patients undergoing AV repair have intraoperative pre- and post-repair transesophageal echocardiography (TEE) with ultrasound systems Sonos® 7500 and since 2006 the iE33 xMATRIX® (Philips Medical Systems, Netherlands). Images were acquired by an anesthesiologist or cardiologist experienced in echocardiography and stored in a database. Pre-repair TEE was performed after induction of anesthesia, before aortic cannulation and post-repair TEE was performed after weaning from cardiopulmonary bypass. AV function and geometry, as well as proximal aorta dimensions were assessed during those examinations. The VAJ dimension was assessed on mid-esophageal long axis view of the AV passing through the middle of the valve.

For this study, pre- and post-repair VAJ diameters were measured by one experienced operator. The VAJ diameter was measured in all patients at the level of cusp insertion during end-systole according to the American Society of Echocardiography guidelines [13] (Fig. 1). When several long axis views were available, the VAJ diameter was measured on each views and the largest measure was recorded. If a long axis view was missed (n = 16) or if the image was not of sufficient quality to reliably measure the VAJ diameter (n = 9), the patient was excluded from the study.

Follow-up

Follow-up was conducted through outpatient visits or telephone follow-up by a research nurse. Information on survival status and valve related complications, including thromboembolism, haemorrhage, endocarditis, reoperation, and cardiovascular symptoms, was obtained as defined in published guidelines. AV function was followed on transthoracic echocardiography (TTE) obtained in all patients predischarge and at regular intervals during follow-up. The degree of regurgitation, evaluated by color-flow Doppler mapping, was staged as absent, mild, moderate and severe. Trans-valvular gradients were calculated from the continuous doppler waves, using the Bernoulli equation. Median follow-up was 53 months (range 6–140) in the subcommisural annuloplasty group and 42 months (range 2–95) in the VSR group. Follow-up was 100% complete in the subcommissural annuloplasty group and 94% complete in the VSR group.

Statistical analyses

Continuous data are presented as mean ± standard deviation or median (range) for nonparametric data. Failure time data on reoperation, and recurrent AR > 1+ are presented using Kaplan–Meier survival curves. Patients undergoing AV re-repair were not re-entered into the database for calculation of reoperation-free survival. The date of the first diagnosis of recurrent AR greater than grade1+ was recorded for time-to-event calculation. Linear correlation between VAJ size and patient characteristics was measured by the Pearson correlation coefficient. Univariate comparisons between groups for failure time data were performed using the log-rank test. Statistical analyses were performed using SPSS software (SPSS 17.0; SPSS Inc., Chicago, IL, USA). Graphs were constructed using GraphPad Prism 5.0 (San Diego, Calif). Statistical significance was considered for P value less or equal than 0.05.
RESULTS

Operative results

Patient demographics are listed in Table 1. Age, gender, previous cardiac surgery, the degree of preoperative AR and left ventricular function were all similar between groups. Patients in the VSR group were less symptomatic than those in the SCA group. They also presented with greater aortic root and ascending aorta diameters; however, the VAJ diameter was similar between groups (Tables 1 and 2).

Aortic cusp repair was performed in nearly all the patients (Table 3). Raphe repair using resection and primary closure or pericardial patch extension was slightly more frequent in the SCA group (P = 0.08). The rate of raphe repair using resection and patch extension was 22% in SCA and 16% in VSR (P = 0.60). Repair of cusp prolapse and repair of cusp perforation was similar in both groups. Associated procedures were more frequently performed in the SCA group (P = 0.02) and cardiopulmonary bypass time was longer in the VSR group (P < 0.01). There was no hospital mortality.

Table 1: Patient demographics

<table>
<thead>
<tr>
<th></th>
<th>SCA group (n = 53)</th>
<th>VSR group (n = 65)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>44 ± 11</td>
<td>45 ± 12</td>
<td>0.38</td>
</tr>
<tr>
<td>Male gender</td>
<td>50 (94%)</td>
<td>61 (94%)</td>
<td>0.78</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>2 (4%)</td>
<td>2 (3%)</td>
<td>0.76</td>
</tr>
<tr>
<td>NYHA functional class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>18 (34%)</td>
<td>39 (60%)</td>
<td>0.01</td>
</tr>
<tr>
<td>2</td>
<td>30 (57%)</td>
<td>20 (31%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5 (9%)</td>
<td>6 (9%)</td>
<td></td>
</tr>
<tr>
<td>AR grade ≤1</td>
<td>6 (11%)</td>
<td>19 (29%)</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>8 (15%)</td>
<td>8 (12%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>28 (53%)</td>
<td>23 (35%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>11 (21%)</td>
<td>15 (23%)</td>
<td></td>
</tr>
<tr>
<td>Left ventricular ejection fraction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVEF &gt;50%</td>
<td>48 (90%)</td>
<td>61 (94%)</td>
<td>0.51</td>
</tr>
<tr>
<td>LVEF 30-50%</td>
<td>4 (8%)</td>
<td>4 (6%)</td>
<td></td>
</tr>
<tr>
<td>LVEF &lt;30%</td>
<td>1 (2%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Proximal aorta diameter (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinuses of Valsalva</td>
<td>38 ± 5</td>
<td>44 ± 6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Sinotubular junction</td>
<td>34 ± 5</td>
<td>39 ± 7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ascending aorta</td>
<td>39 ± 8</td>
<td>46 ± 8</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

NYHA: New York Heart Association; LVEF: left ventricular ejection fraction.

Table 2: Pre- and post-repair transesophageal echocardiographic measure of ventriculoaortic junction

<table>
<thead>
<tr>
<th></th>
<th>Preoperative VAJ diameter</th>
<th>Postoperative VAJ diameter</th>
<th>VAJ reduction</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCA</td>
<td>28 ± 3</td>
<td>24 ± 4</td>
<td>4 ± 2</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>VSR</td>
<td>28 ± 3</td>
<td>21 ± 2</td>
<td>7 ± 2</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>( p^b )</td>
<td>0.16</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td></td>
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</tbody>
</table>

VAJ diameters are expressed in mm.
SCA: subcommissural annuloplasty; VAJ: ventriculoaortic junction; VSR: valve sparing reimplantation.
\( p^a \) Compare preoperative and postoperative annulus diameter in within each group.
\( p^b \) Compare variables between groups.

Figure 1: Transesophageal echocardiographic long axis view of the aortic valve and root before repair (left panel) and after repair (right panel). (A, B) The ventriculoaortic junction diameter in VRS before and after repair. (C, D) The ventriculoaortic junction diameter in SCA before and after repair.
Effect of annuloplasty on ventriculoaortic junction diameter

Overall mean preoperative VAJ diameter was 28 ± 3 mm, ranging from 20 to 38 mm and the mean indexed VAJ diameter (VAJ/body surface area) was 1.4 ± 0.2 mm. The VAJ diameter was moderately correlated to patient's age (r = 0.31, P < 0.01) with larger VAJ observed in younger patients. In patients under 40 years of age, mean VAJ diameter was 29 ± 3 mm compared with 27 ± 3 mm in those above 40 years (P < 0.01). No correlation was found between VAJ diameter and body surface area (r = 0.12, P = 0.21) or between VAJ and sinus of Valsalva diameter (r = 0.11, P = 0.23). VAJ diameter was significantly larger in patients with AR ≥ 3+ compared to patients with less or no AR (29 ± 3 vs 26 ± 3 mm, P < 0.01). Mean pre- and postoperative VAJ diameters in SCA and VSR groups are detailed in Table 2. Preoperative VAJ diameter was similar between the two groups. In both groups, the VAJ diameter was significantly reduced comparing pre- and postoperative measures. However, VAJ diameter was significantly more reduced in VSR compared with SCA with a 3 mm difference between mean VAJ reduction in VSR (7 ± 3 mm) vs SCA groups (4 ± 2 mm) (P < 0.01).

Long-term outcomes

There was no mortality during the follow-up period. In univariate analysis, patient ≥ 40 years, preoperative AR ≥ 3+ and raphe repair were not predictive of AV reoperation nor recurrent AR > 1+ (Table 4). In contrast, SCA annuloplasty and postoperative VAJ diameter ≥ 25 mm were predictive of AV reoperation and recurrent AR > 1+; preoperative VAJ diameter ≥ 30 mm and the use of pericardial patch for cusp repair were predictive of recurrent AR > 1+.

At 6 years, freedom from recurrent AR > 1+ was 81% in patients with preoperative VAJ diameter < 30 mm compared with 60% in patients with VAJ diameter ≥ 30 mm (P = 0.03, Fig. 2A). The difference observed was largely related to the differences in AR recurrence existing in the SCA group for patients with a VAJ diameter < 30 mm compared to those with a VAJ diameter ≥ 30 mm (74 vs 39%, P = 0.01, Fig. 2B). In the VSR group, preoperative VAJ diameter ≥ 30 mm had no significant effect on recurrent AR > 1+ (P = 0.93, Fig. 2B).

Figure 3 shows the proportion of recurrent AR among different sizes of VAJ in SCA and in VSR. In SCA, recurrent AR was observed in approximately 20% in each category of VAJ size, except over 30 mm, where it increased over 80%. In the VSR group, recurrent AR was less frequent in each category and did not increase in those over 30 mm of VAJ diameter.

In other words, among the patients with preoperative VAJ diameter ≥ 30 mm, freedom from recurrent AR > 1+ was significantly higher in the VSR group compared with SCA (94 vs 39%, P = 0.01). Freedom from recurrent AR > 1+ remained higher in the VSR group even when the entire study cohort was considered (93 vs 65%, P < 0.01).

With regard to postoperative VAJ size, freedom from recurrent AR > 1+ at 6 years was 86% in patients with postoperative VAJ diameter < 25 mm compared with 30% in patients with VAJ diameter ≥ 25 mm (P < 0.01). (Fig. 3A) As for preoperative VAJ size, the difference was mainly related to the difference existing in the SCA group between postoperative VAJ diameter < 25 mm and ≥ 25 mm (80 vs 31%, P < 0.01, Fig. 3B). In the VSR group, only three patients had postoperative VAJ diameter ≥ 25 mm.
DISCUSSION

As part of the functional aortic annulus (FAA), the VAJ and the STJ both play a crucial role in aortic valve competence [8, 9, 14]. Abnormal enlargement of those structures, encountered in congenital or degenerative connective tissues diseases, can lead to valve regurgitation. While the surgical correction of STJ is relatively easy with an external Teflon strip or by replacement of ascending aorta with tubular Dacron graft, the remodeling and stabilization of the VAJ are more complex as this three-dimensional structure is deeply embedded in the heart. As a consequence, the remodeling of enlarged VAJ has frequently been ignored or neglected in AV-sparing procedures, decreasing the durability of the repair. [6, 7, 15–17].

In patients with ‘normal’ tricuspid aortic valve (TAV), echocardiographic studies have shown that the size of the VAJ ranged from 23 to 26 mm [18]. Patient’s age and body surface area were the factors most influencing VAJ size; whereas body mass index, gender and blood pressure have much less or no influence on VAJ size [18, 19]. In this study, we showed that in a population of patients with BAV regurgitation and/or aneurysm selected for AV repair, the mean VAJ size (28 ± 3 mm) was greater than in patients with normal TAV. The inverse correlation observed with patient age and the absence of correlation with body surface area suggest that, in BAV, the VAJ size does not follow the physiological patterns observed in TAV. The VAJ enlargement may be the result of the aortopathy associated with BAV and may be driven by genetic or haemodynamic factors [20, 21].

For several years, we have liberally used VSR in BAV repair to optimize stabilization of the FAA, particularly of the VAJ. With this approach, we have significantly improved the durability of the repair with no measurable increase of morbidity or mortality [7]. The factors that positively influenced the results with the VSR are probably multiple. In this study, we have focused our analysis on VAJ remodeling to identify its effect on the outcomes. Firstly, we have found that circumferential prosthesis-based annuloplasty provided by the VSR induces greater intraoperative reduction of the VAJ compared with non-circumferential SCA (7 vs 4 mm). As a consequence, the ratio of cusp tissue to VAJ area

![Figure 2](https://academic.oup.com/ejcts/article-abstract/44/2/316/440808)

Figure 2: (A) Kaplan-Meier actuarial survival curves comparing freedom from recurrent AR ≥1+ on basis of preoperative ventriculoaortic junction (VAJ) diameter ≥30 mm in the entire cohort (P = 0.03). (B) Kaplan-Meier actuarial survival curves comparing freedom from recurrent AR ≥1+ on basis of preoperative ventriculoaortic junction (VAJ) diameter ≥30 mm in subcommisural annuloplasty (SCA) and valve sparing reimplantation (VSR) groups (SCA < 30 mm vs SCA ≥30 mm, P = 0.01; VSR < 30 mm vs VSR ≥30 mm, P = 0.93; SCA ≥30 mm vs VSR ≥30 mm, P = 0.01; SCA < 30 mm vs VSR < 30 mm, P = 0.16).

![Figure 3](https://academic.oup.com/ejcts/article-abstract/44/2/316/440808)

Figure 3: Graphs presenting the proportion of recurrent AR among different size categories of ventriculoaortic junction in subcommissural annuloplasty (SCA) and in valve sparing reimplantation (VSR). (In SCA, VAJ ≥31 mm vs any other VAJ size categories, P < 0.05; in VSR, no differences between VAJ size categories; SCA ≥31 mm vs VSR ≥31 mm, P < 0.01).
increases and this leads to increased cusp mobility and greater coaptation reserve. Secondly, we have shown that after SCA, recurrent AR was highly correlated to preoperative VAJ size (≥30 mm preop, ≥25 mm postop), whereas after VSR, it was independent of preoperative VAJ size. Also, we have shown in previous work that in patients needing reoperation for recurrent AR, the VAJ dilates over time [7]. Therefore, we can reasonably conclude that VSR annuloplasty provides better stability over time compared with SCA. Finally, the rate of recurrent AR in SCA was higher compared with VSR in small VAJ sizes also (Fig. 3), indicating that other factors, like cusp morphology or cusp repair technique, are involved in the difference observed between the two groups. One factor identified by the univariate analysis was cusp repair with pericardial patch, which was used more frequently in the SCA group.

Supporting our findings, Aicher et al. have shown in a large series of BAV repair, a higher rate of reoperation in patients with VAJ ≥ 29 mm and this despite the fact that SCA was performed in those patients with large VAJ. They have found improved repair durability also in patients having valve sparing root remodeling and in patients with commissural orientation ≥160°. As we routinely make the valve symmetric (commissural orientation of 180°) with VSR, both their and our results suggest a benefit of

restoring the FAA geometry in BAV repair with a certain degree of valve symmetry (Fig. 4).

In light of this data, the surgical approach of BAV preservation and repair should include robust VAJ remodeling and stabilization (e.g. VSR) whenever the VAJ is ≥29 mm. In patients with VAJ < 29 mm, the necessity of such a strong VAJ remodeling and stabilization is perhaps less important. Given the presence of aortopathy in BAV disease, VAJ enlargement is possible over the years exposing young patients in particular, to significant cumulative risk of repair failure. Therefore, we remain more aggressive in young patients (<40 years) and recommend robust VAJ stabilization in patients with preoperative VAD diameter over 26 mm; in older patients, SCA can remain an option when the aortic root is not dilated.

In patients who require significant remodeling and stabilization of the VAJ, VSR is ideal in case of root dilatation. In the absence of root dilatation, however, other circumferential prosthesis-based annuloplasty systems exist, but are still under preclinical or clinical investigation. Lansac et al. have shown good mid-term clinical results with an external aortic ring principally implanted in TAV [22]. They reported no specific complication in BAV repair with this ring; however, concerns remain regarding the appropriate position of the ring in the anterior septal portion of the VAJ where the conjoint cusp can be deeply inserted on the muscular septum. An internal rigid ring is under investigation by Rankin et al. but feasibility data in BAV are not yet available [23]. Finally, until a specific device or technique has proven its utility in remodeling and stabilizing the VAJ in BAV repair, VSR remains in experienced hands, an excellent technique even in patients with normal or mildly dilated aortic roots.

Study limitation

The limitation of the study is related to its retrospective design that covers a period during which surgical approach of BAV has evolved in favor of the VSR. Therefore, patients with VSR present with a mean follow-up shorter than those having SCA, and we can assume that being operated on later, they have benefited from the cumulative surgical experience. In contrast to our previous work, the SCA and VSR population were not matched to avoid working on small samples size. In consequence, the groups compared present several baseline differences that could have been confounding factors in our analysis. In AV repair, failure results mainly from morphological and technical factors; therefore, the role of those factors was analyses by the univariate analysis. Lastly, we examined and studied, in this manuscript, only one index of VAJ size, i.e. the diameter. With growing use of 3D echocardiography, it is increasingly recognized that the VAJ is not circular in shape, but rather resembles an ellipse. Therefore, a single measure (e.g. diameter) may not be an adequate descriptor of VAJ size. Furthermore, off-axis measurements may have introduced non-systematic error into the assessment of VAJ diameter.

CONCLUSION

Patients with BAV regurgitation and/or aneurysm present frequently with relatively large ventriculoaortic junctions. The circumferential prosthetic-based annuloplasty of the VSR procedure offers greater reduction of the ventriculoaortic
juncture compared with the non-circumferential annuloplasty provided by subcommissural annuloplasty. In patients having BAV repair with subcommissural annuloplasty, ventriculoaortic junction size ≥ 30 mm preoperatively and ≥25 mm postoperatively are significant predictors of recurrent AR. Therefore, in experienced hands, VSR is an excellent alternative to treat patients with regurgitant BAV who present with ventriculoaortic junction enlargement even in the absence of aortic root aneurysm.

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Conflict of interest: none declared.

REFERENCES


APPENDIX. CONFERENCE DISCUSSION

Dr M. Nasol (Bratislava, Slovakia): In your study you compared two aortic annuloplasty techniques, both of which seemed to reduce the ventricular-aortic junction size significantly, but the subcommissural annuloplasty fails to preserve aortic function during the follow-up and fails to preserve the diameter of the ventricular-aortic junction. I have two questions.

In the subcommissural annuloplasty group, the patients were older and more symptomatic before operation. Those patients needed raphe resection more frequently, and five of them required intraoperative re-exploration. These are all factors which might affect the immediate post-operative aortic valve function. So my first question is: was there any difference in the immediate postoperative aortic valve function between the groups?

Dr Navarra: We didn’t observe differences in immediate results. But during the follow-up we found a constant rate of regurgitation in every category of V AJ size in the subcommissural annuloplasty group, and that probably due to the fact that we perform a raphe repair more often in this group, most likely because there was a higher rate of type I bicuspid valve in this group. In some patients, as Gebrine said before, we don’t have enough cuff tissue so pericardial patch repair is necessary to have an adequate leaflet size and, of course, that could affect the results.

Dr Nasol: My second question is about the use of pericardium, which appears to be a risk factor for recurrent aortic regurgitation in your group. What is your current approach, do you still use pericardium or would you consider a different material such as Gore-Tex, for example, which might be less prone to calcification or fibrosis?

Dr Navarra: Well, sometimes we still need to use a pericardial patch. We are testing other material, but this is still in an experimental project.

Dr T. Shimamoto (Kurashiki, Japan): I have one question. Your centre is really experienced, you can perform the reimplantations very quickly. But your message is that, for example, for the sick patients we should not perform subcommissural annuloplasty, or is there any way of drawing the line between - is there still room for performing subcommissural annuloplasty, for example, if you plicate the annulus lower than 21, 20, do you think that is still forgivable?

Dr Navarra: I did not understand your question.

Dr Shimamoto: I just mean that you said your message is that we should not perform subcommissural annuloplasty for every patient, or is -
Dr Navarra: No, that is not the message. We found that the degree of VAJ reduction provided by the subcommissural annuloplasty is less important than with valve-sparing reimplantation. And observation of patients who have a preoperative diameter above 30 mm, and of patients with a postoperative diameter above 25 mm, clearly shows the superiority of the reimplantation technique. Subcommissural annuloplasty provides some reduction, so can be a good option in some patients. But, for severe VAJ dilatation, we think that the reimplantation technique provides a higher degree of reduction and adds a stabilization of the annulus over time.

Dr C. Antona (Milan, Italy): Only a short comment. I think that there is a mistake, because this is not an annuloplasty. A couple of stitches represents a subcommissural triangular reshaping. Annuloplasty is complete, and involves an internal/external ring, such as a Lansac ring. My question is: what do you think is the applicability for this technique - is this for the tricuspid valve, or for the bicuspid valve? Because there is a role for the reshaping of triangles in the tricuspid valve. What is your experience?

Dr Navarra: I think that subcommissural annuloplasty has a role in reshaping the annulus in the tricuspid aortic valve, again in the patients who have a small VAJ diameter. In a bicuspid aortic valve, we think that the patient needs greater remodelling and stabilization of the dilated VAJ. About the first comment, yes, I agree with you, the subcommissural annuloplasty is not a complete annuloplasty, it’s a stitch-based annuloplasty, a partial annuloplasty at the level of the commissures.