Work in progress report - Congenital

No patch technique for complete atrioventricular canal repair

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Abstract

We describe our initial experience with a new technique, consisting in direct closure of the ventricular septal defect component of the AV canal, by directly attaching the common bridging leaflets to the crest of the ventricular septum with interrupted sutures. After closure of the cleft, the ostium primum defect was closed with a running suture suturing the border of the septum primum to the newly created AV valve annulus. Three patients were operated upon. There was no mortality. Mean ischemic time was 39 min and mean pump time 77 min. All patients remained in sinus rhythm. At follow-up only trivial or mild mitral regurgitation was observed. This new technique permits the repair of complete AV canal without the need for any patch. It is fast, simple and reproducible.

Keywords: Congenital heart disease (CHD); CHD septal defects; Infant

1. Introduction

The surgical techniques for repair of complete AV canal have evolved in recent years, avoiding the need for the patch at the ventricular level [1] and, more recently, at the time of the closure of the ostium primum defect [2]. We present an evolution of both techniques avoiding the need of any patch by directly closing both defects.

2. Materials and methods

In January 2002 we began our program of no-patch technique for repair of complete AV canal. Until January 2006 a total of 32 patients diagnosed with AV canal defects were operated upon. Of them, 18 had complete AV canal (10 Rastelli type A, 6 Rastelli type C, 1 Rastelli type B and 1 canal + tetralogy of Fallot), 6 had transitional type AV canal defect, and 8 partial AV canal defect. In the complete AV canal group, 5 patients were repaired with the two-patch technique (early in the series), 10 were repaired with direct closure of the VSD component [1] and, starting March 2005, the last 3 patients were operated on with no-patch at neither the ventricular nor the atrial level. These three patients are the basis of this study. All the transitional AV canal patients were repaired with direct closure of the VSD component. In the partial AV canal group, 4 were repaired with a pericardial patch and 4 without a patch at the atrial level [2]. These patients serve as a control group. Demographic data are reported in Table 1. Mean age at operation was 6 months. Anatomy was categorized as Rastelli type C in the first patient and type A in the other two patients (Fig. 1). The VSD component of the canal was considered large in one and functionally small in two (there were abundant chordae in the anterior and posterior part of the VSD). The definition of the defect was made according to the consensus for international nomenclature [3]. Both type A AV canal patients had a single AV valve with anterior and posterior bridging leaflets and a bare area in the mid-portion of the crest of the ventricular septum. Quality of the repair was assessed by transesophageal echocardiogram in the operating room. Patients were followed-up by their cardiologists by transthoracic echocardiogram. Mean follow-up was 7 months.

3. Surgical technique

Patients were operated upon under general anesthesia, median sternotomy, standard cardiopulmonary bypass, moderate (30°) hypothermia and intermittent cold blood cardioplegia. Modified ultrafiltration was done in all cases. The defect was approached through a right atriotomy. The bridging leaflets were not severed. The VSD component was closed directly without the need for a patch according to the technique described by Wilcox et al. [4]. We used U shaped interrupted sutures of 6/0 single pledgeted Premium polypropylene (Peters, Paris, France) (Video 1). The pledget was left in the right ventricular aspect of the interventricular septum close to the crest of the defect. The stitches were then passed through the corresponding bridging leaflet and were directly tied. In the large VSD defect 6 sutures were needed. In the two Rastelli type A patients the anterior and posterior part of the VSD was covered with chordae tendinae. The central bare area of the VSD was closed with two stitches. The cleft was closed in the usual fashion with interrupted sutures of 6/0 Pronova (Ethicon,
Table 1
No-patch patients characteristics

<table>
<thead>
<tr>
<th>Patient N</th>
<th>Age at operation (months)</th>
<th>Rastelli type</th>
<th>Size of VSD</th>
<th>Pump time</th>
<th>Ischemic time</th>
<th>Extubation time (h)</th>
<th>Postop M regurgitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>C</td>
<td>Large</td>
<td>104</td>
<td>46</td>
<td>72</td>
<td>Mild</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>A</td>
<td>Small</td>
<td>54</td>
<td>33</td>
<td>36</td>
<td>Trivial</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>A</td>
<td>Small</td>
<td>75</td>
<td>38</td>
<td>24</td>
<td>Trivial</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>6</td>
<td></td>
<td>77</td>
<td>39</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1. Echocardiogram (four-chamber view). A, preoperative; Rastelli type C AV canal with a large VSD. B, postoperative in the same patient; ‘normal looking’ heart except for the same level implantation of the mitral and tricuspid valves.

Sommerville New Jersey). Once AV valve competence was assessed, the ostium primum defect was closed according to Prêtre et al. [2]. A running suture of 6/0 Pronova was started at the superior edge of the defect joining the crest of the defect to the newly created AV valves partitioning. (Video 2). Bites were passed through the ‘septal tricuspid leaflet’ one millimeter to the right of the previous sutures closing the VSD (Fig. 2). The suture is then passed through the crest of the defect. Gentle traction on the septum primum with forceps easily brings the crest of the defect to the AV valve level and most of sutures are passed with a single bite. This suture line is completed with a second suture of 6/0 Pronova that is started at the inferior part of the defect where the inferior part of the crest of the ostium primum joints the posterior leaflet with superficial bites on the inferior AV valve leaflet running slightly obliquely until the level of the ventricular septum is reached. Then we proceed one millimeter to the right on the tricuspid leaflet until we join the previous suture and both are tied. The coronary sinus is left draining to the right atrium. The patent foramen ovale is closed as needed and the rest of the operation is completed in the usual manner.

4. Statistical analysis

Student’s t-test was used for comparison of the means unpaired.

5. Results

Mortality for the whole series was 1 patient (3%). Death occurred in one patient repaired with conventional two-patch technique. There was no mortality in the no-patch patients. Mean ischemic time was 39 min and mean pump time 77 min. All patients remained in sinus rhythm at all times. The first patient presented some crisis of pulmonary hypertension requiring inhaled nitric oxide. He was extubated at 72 h postoperatively. The other two patients were extubated at 36 and 24 h, respectively. At follow-up only trivial or mild mitral regurgitation was observed. In patient 1 a small 2 mm residual VSD was observed in the posterior aspect full of chordae that was left untouched. The result remained stable over time in all patients. In Table 2, the results with no-patch technique are compared with the conventional technique in terms of ischemic and pump times. There was no statistically significant difference between the no-ventricular patch and no-patch technique, but both techniques showed significant lesser times than standard two-patch technique for complete AV canal. In partial AV canal, avoiding atrial patch shows a significant reduction in ischemic and pump times compared to the use of atrial patch.

6. Comment

Complete AV canal defect is a complex anatomic lesion that, nevertheless, has been amenable to surgical repair...
since the early era, thanks to the pioneering work of Rastelli and coworkers [5] who simplified and rationalized the classification of the defect. The initial technique of division of the common leaflet and single patch [6,7] gave way to the two-patch technique that has been the technique of choice until recently for most centers [8]. A common difficulty to both techniques lies in how to calculate the height where to attach the divided leaflets to the single patch or the height of the VSD patch. If the new left AV valve lies too high there is a risk of creating a restricted leaflet motion in systole of the ‘anterior’ leaflet with a small area of coaptation and subsequent incompetence. Nicholson et al. [1] proved that the VSD patch could be avoided in most cases of complete AV canal by simply attaching the common leaflets to the crest of the septum. The technique of direct closure of VSD was first reported by Wilcox et al. [4], but it was Lillehei who first used it in 1954, as was reported by DW van Hooekeren and colleagues (van Hooekeren DW, Spector ML ‘Tethering the common atrioventricular valve to preserve spatial relationship during repair of common atrioventricular valve’ presented at the II World Congress of Pediatric Cardiology, New York 1985). This technique has been our routine since 2002, with the exception of 5 simultaneous patients in the beginning of our experience who were operated on with the two-patch technique. Our progression went from first direct suture of the VSD component, then avoiding the atrial patch in the partial AV canal and finally, no-patch at both levels in complete AV canal. The main advantage of not using a VSD patch is that by lowering the level of the left AV valve implantation at the crest of the septum the area of coaptation is increased resulting in better competence. Another advantage is that it simplifies the procedure reducing both ischemic and total pump times. Prêtre uses the same principle but at the atrial level. It reduces operating time and gets normal sized atria that were dilated preoperatively. Although there are other factors involved, like the presence of residual valve incompetence, type of myocardial protection, etc., achieving a normal sized atrium may help in preventing the occurrence of postoperative arrhythmias. One concern with this technique is the risk of applying too much tension on the tissues and subsequent tear due to the fact of not using any patch. The main feature in AV septal defects is the absence of the atrioventricular septum. In the normal heart this is a rather small area of the septum. It is the dilatation of the atria that produces a separation and elongation of the edges of the defect, especially at the ostium primum level. In the infant the atrial septal tissue is very elastic and permits the apposition of the edge of the septum against the valve level without excessive tension. Prêtre proved that direct closure of the atrial septal defect can be safely achieved regardless of the size of the defect, even in older children like in partial AV canal (mean age 3 years). Although it could be possible to close the defect by applying one single line of sutures grasping the ventricular septum, valve tissue and the atrial edge, this could suppose excessive tension on the tissue. We prefer to use two suture lines one millimeter apart, one for the ventricular defect and another for the atrial one. This way the tension is evenly distributed, avoiding the risk of tearing.

In conclusion, this new no-patch technique permits the repair of complete AV canal without the need for any

Table 2

<table>
<thead>
<tr>
<th>Complete AV canal</th>
<th>Two-patch</th>
<th>No-patch</th>
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<tbody>
<tr>
<td>Mean age months</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Mean ischemic time</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>Mean pump time</td>
<td>86</td>
<td>116</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Partial AV canal</th>
<th>Atrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>No atrial patch N</td>
<td>4</td>
</tr>
<tr>
<td>Atrial patch N</td>
<td>4</td>
</tr>
</tbody>
</table>

| Mean age years     | 4.7      | 18       |
| Mean ischemic time | 29       | 48       |
| Mean pump time     | 53       | 86       |
patch. It is fast, simple and reproducible. Initial results are promising, but further studies are required to confirm the findings and identify what patients can benefit from this technique.

References


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eComment: I read with great interest the innovative technique of Aramendi et al. [1] to repair complete atrioventricular canal defect. Modifications of ‘No-patch’ techniques have been sporadically attempted by some surgeons; but, since these studies usually included a limited number of patients, it is not possible today to draw definite conclusions about its long-term durability. I totally agree with the authors that this technique can be used in most of the patients and offers significant advantages. However, as the authors stated in the article, the main concern is the risk for the development of tension-related complications. This is especially true for patients with a large ventricular component. In such patients, tearing is a possible complication; but, more importantly, the absence of a patch material under valvular tissue may be also associated with a risk of postoperative left ventricular outflow tract (LVOT) obstruction. Therefore, it would be more helpful if the authors gave us information about the incidence of postoperative LVOT obstruction.

References