Rastelli one-patch procedure for complete atrioventricular septal defect repair

Komplet atriyoventriküler septal defekt tamirine yönelik Rastelli tek yama işlemi

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Repair of the complete atrioventricular septal defect, as with many other congenital heart defects, has changed with time from the one-patch technique (Rastelli) to the two-patch technique and then to the “modified” one-patch technique. In this review, we have reported our experience with one-patch Rastelli type correction in babies under one-years of age. Our experience confirmed that the classical one-patch Rastelli technique is a safe, reproducible, teachable technique giving satisfactory late results.

Key words: Mitral valve; one-patch technique; reoperation; atrioventricular; two-patch technique.

TECHNICAL STEPS IN THE ONE-PATCH RASTELLI-REPAIR

Chest opening and preliminary acts

After installing standard monitoring (rectal and oesophageal temperature, arterial line, central venous line etc.) the patient’s chest is opened by a median sternotomy. A large piece of pericardium is harvested and treated in 0.6% glutaraldehyde. Cannulation is made in the ascending aorta and vena cava. Normothermic cardiopulmonary bypass (CPB) is instituted (In the first years of our experience, we were using deep hypothermic circulatory arrest, thus using only one right atrial cannula). Just before the initiation of CPB or just after, the patent ductus arteriosus is controlled and ligated with silk or occluded with a clip.

Cross-clamping of the aorta and cardioplegia injection is done in the ascending aorta.

Right atrial incision and lesions evaluation

The right atrium (RA) is opened vertically and the lesions are carefully evaluated, after a vent catheter
is introduced in the left atrium (LA), through the atrial component of the complete AVSD or through a secundum defect, often present.

- Recognition of the anatomic type of defect

Despite the various subsequent pathology descriptions, we still use the initial description by Rastelli et al.,[6] which in surgical practice represents a very comprehensive view.

**Type A:** Anterior common leaflet divided and attached by chordae to the septal crest (40% in our experience). The division of the common leaflet is rarely complete, extending sometimes to the annulus and the zone of aorto-mitral fibrous continuity (Fig. 1b). Most often it is partial.

**Type C:** Anterior common leaflet undivided and unattached to the ventricular septal crest (60% in our experience; Fig. 1a).

The type B is a type we have had problems to clearly understand and we think we have not seen one.

In both A and C types, there is a posterior common leaflet, almost always undivided and always attached by numerous chordae to the muscular ventricular septal crest. The other left-sided leaflet (the mural) will be commented on later.

- Appreciation of the respective size of the ventricular and atrial components of the septal defect

This is a very important step, since the size of the ventricular aspect of the patch, and subsequently the level of attachment of valvular components to it, is critical. From its adequate width and height depends the possibility to get “mitral” insufficiency or subaortic stenosis. One way to appreciate this is to fill the left ventricle (LV) with saline, so that the actual level of the coaptation area is seen, or measured. It can be helped by placing a suture at the junction point between the anterior and posterior common leaflet, but we generally do not do it.

- Careful examination of the leaflet anatomy and the subvalvular apparatus (particularly on the left-sided or “mitral” component)

In addition to identifying the type of complete AVSD, several features of the anatomy of the valves need careful examination, since the valvular procedure will depend on these findings: the thickness of the tissue,
and of the edges of the “apposing zone” (or “cleft”), the presence of a double mitral orifice (Fig. 1c), the tissue gap between anterior and posterior common valve.

One essential feature is the size of the mural leaflet. It is correlated with the anatomy of the papillary muscles. In general, there are two papillary muscles, and it is known that the inter-papillary distance is shorter than normal, as the size of the valvular components suggests. When there is a very short distance between both muscles, or when there is a single papillary muscle (Fig. 1d), the mural leaflet is narrow and thus the closure of the cleft would lead to mitral stenosis. This condition, known as the “potentially parachute mitral valve”[7] was present in about 10% of the population of our patients. In the past, it has certainly been often unrecognised.

- Gross evaluation of valve competence

The valve competence has been evaluated pre-operatively by echocardiogram, but the evaluation with open atrium is performed with injection of serum under pressure in the LV.

It gives a gross appreciation of valvular competence, and it is recognised that the preoperative valve competence of the complete AVSD is in general satisfactory.

Division of the common leaflets

We start by placing two pilot sutures on the free edge of the anterior common and posterior common leaflet (Fig. 2a). After gentle traction on these sutures, we can evaluate the line of transversal incision which is made. The incision is made leaving a little more tissue for the left-sided component, the future “mitral” valve, to allow a safer attachment to the septal patch.

The incision is extended towards to the annulus on each side, joining the area of mitro-aortic fibrous continuity on one side and the area close to the conduction tissue on the other side (Fig. 2b).

In type A, the common anterior leaflet has a division, and it is easy to extend the native division. In type C, one has to be cautious to decide where to divide the valve, since after the division, there is no good way back!

**Fig. 2.** (a) Pilot sutures are placed on the leaflet and gentle traction is exerted (a case of type C). (b) The anterior and posterior common leaflets have been divided, leaving a little more tissue for the left side. (c) A running suture is made on the right side of the muscular ventricular part of the complete atrioventricular septal defect. (d) The pericardial patch has been totally sutured to the ventricular aspect of the defect.
Suture of the pericardial patch to the ventricular component of the septal defect

The autologous pericardial patch that has been treated in 0.6% glutaraldehyde and carefully rinsed is then used. We take care not to overtreat the pericardium to get a firm but supple tissue to allow easy bites by small and fine needles.

It is trimmed so that a smooth curved shape is obtained to adapt to the ventricular aspect of the defect.

The patch is then sutured to the muscular aspect, on the right ventricular side, at 3 to 4 mm from the edge (Fig. 2c). We use a 5/0 monofilament suture with a half-circle fine needle. The reason to use a half-circle is because we find it easier to handle in the depth of a small heart.

We do a simple running suture ending through the annulus on each side (Fig. 2d).

Attachment of the valve components to the pericardium

It is a critical part of the operation for several reasons:

- The level to which the valve components are attached is important to avoid either valve distortion or production of potential subaortic stenosis
- The solidity of the suture is a guarantee against tearing and production of valve insufficiency.
- The transverse width of the suture on the patch is important to get a competent valve. If inappropriately done the valve attachment can be shrunk or distended. We use a 6.0 monofilament suture taking the valvular components (approximately 2 mm of valve tissue) and the pericardial patch in sandwich. In the midline the anterior and posterior valve components are tightly approximated, to avoid or reduce any gap or between them (Fig. 3a).

After completion of the suture and testing of valve competence with LV filling with saline, we reinforce the suture with 3 to 4 mattress 6/0 sandwiching sutures.

Treatment of the apposing zone or cleft and additional procedures

According to various factors: presence of severe valve insufficiency preoperatively, presence of post repair insufficiency (before closing the atrial aspect of the

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Fig. 3. (a) The valvular components have been sutured to the patch and the sutures tied with the previous ventricular septal defect suture. (b) The cleft has been totally closed in this case with 4 mattress sutures biting the apposing zone. (c) The course of the atrial part of the suture: dotted line: the coronary sinus is left on the left side of the heart, white arrow: the course we use with coronary sinus left in the right atrium. (d) The atrial part of the patch and a sucker is inserted in the coronary sinus, to show the distance between coronary sinus and suture line.
defect), quality of valve tissue at the apposing zone, absence of single papillary muscle, a decision is made to close the cleft entirely or partially, or to leave it intact.

When a suture is applied to the cleft, it is done by mattress 6/0 or 5/0 sutures biting the apposing area and not the free edge (Fig 3b). Suturing the actual free edge might lead to deformation of the valve.

In case of annular dilatation, we perform annuloplasty plication sutures, with mattress sutures using small pericardial pledgets.

Suture of the patch to the atrial component of the defect-end of the procedure

This is done by the continuation of the running suture of the 5/0 prolene, after having tied together the 5/0 ventricular septal and 6/0 valvular running sutures.

There is only one critical point to be described: it concerns the course of the suture vis-a-vis the coronary sinus and subsequently the conduction AV node and tissue (Fig 3c). We use a direct course towards the atrial component passing over the conduction tissue, and leaving the coronary sinus in the RA (Fig. 3d). In the area before reaching the true edge of ASD primum, the sutures must stay superficial (white arrow on figure 3c).

The secundum ASD, often present, is closed separately or with the same patch, incorporated in the repair.

The atrium is then closed with a double running 5/0 suture, de-airing is done in a routine way, and the cross-clamping is released. We routinely finish the operation by leaving a pulmonary artery (oxymeter) and a left atrial catheter, and four stimulation electrodes (2 atrial and 2 ventricular), inserted before weaning CPB.

RESULTS AND COMMENTS

We have reported\(^5\)\(^,\)\(^8\) our experience with one-patch Rastelli from 1985 to 2006 in babies less than one-year. It involved 107 cases among 129 cases of complete AVSD, with a total of 265 AV septal defects. The overall operative mortality has been 13%, lowered to approximately 4% in the past 10 years. The main cause of hospital mortality was acute pulmonary hypertension, this problem being much better taken care of in the recent period. There was no permanent complete AV block needing pacemaker implantation. At the last outpatient clinic, 85 patients were asymptomatic without treatment and five patients had cardiac medications. At the last echocardiographic assessment, there were no patients with severe mitral regurgitation (MR), three with moderate MR, 30 with mild MR, and 57 with absent or trivial MR.

One interesting point is the long-term follow-up of the operative survivors and the freedom from reoperation for “mitral” insufficiency. In our experience in most cases, after reattachment of the valve components to the patch and evaluation of the competence, the cleft was closed completely in eight cases, closed partially in 29 cases, and left intact in 70 cases. A commissuroplasty was added in six cases. The fact of closing or not closing did not show a difference (although not significant) in the need to late reoperation of mitral insufficiency.

![Graph showing freedom from late reintervention for MR](image)

**Fig. 4.** Freedom from reoperation for mitral insufficiency at 5, 10, 15 and 20 years. There is no significant difference when the cleft was sutured (totally or partially) or left intact.
We favour a flexible approach to this problem reserving closure for when a severe preoperative insufficiency is present (rare), when the tissue is very dysplastic, avoiding approximate fine tissue with sutures and of course never doing it in potentially parachute mitral valve. Overall freedom from reoperation for mitral insufficiency was very satisfactory: 96.7% at five years, 94.6% at 10 years, 91.9% at 15 and 20 years (Fig. 4).

In the literature, when a reoperation was needed[9-11] it often concerned cases where the cleft had been closed at the first operation and where it reopened. In our experience in five patients (6 reoperations), reoperations after a delay from 2-13 years for mitral insufficiency, three had had closure of the cleft at first operation. In our view, this means that simple closure of the cleft does not represent the solution for absence of appearance of late mitral insufficiency and some other factors must be taken into consideration (commisural dilatation, lack of valvular tissue, etc). Another type of need for reoperation needs to be quoted. It concerns the late reoperation for subaortic stenosis. The occurrence of this problem was 3% in our group, as in many other reports, successfully treated by subaortic stenosis fibrous tissue resection.

We would like to comment on why we use the Rastelli single-patch and not the double-patch, done by other centers. In recent Gallup's at meetings of the Society of Thoracic Surgeons (STS) are the European Association for Cardio-Thoracic Surgeons (EACTS), it appeared that approximately 50% of centers were doing two patches, 30% the classical Rastelli, and 20% the modified “Australian” one-patch; (i) we have been trained in a center were it was the procedure of choice,[12,13] (ii) the two-patches (without dividing the common leaflets) does not “save” more valvular tissue than our routine technique; (iii) under the posterior common leaflet, with frequently many chordae, it is not simple to safely insert a ventricular septal defect patch (the users themselves mention it); (iv) also, and principally, there is no evidence in the literature that the results have been better with two patches.[14-16]

Finally, the modified “Australian” technique of one-patch, transforming somehow the complete AVSD into a partial AVSD may also lead to mitral insufficiency changing the chordae geometry (Reddy M; personal communication), and may also lead in the future to subaortic stenosis, a postoperative gradient, even reduced, being reported postoperatively.[2]

In conclusion, the classical one-patch Rastelli technique is a safe, reproducible, teachable technique giving satisfactory late results, and as Wirklin and Barratt-Boyes wrote[17] “there continues to be a considerable variety in techniques used in the repair, and properly used, all techniques appear to provide good results ….”

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REFERENCES