Lecompte operation with preservation of the pulmonary valve for anomalies of ventriculoarterial connection with ventricular septal defect and subpulmonary stenosis

Abstract
A modification of the Lecompte operation is reported in which the pulmonary valve is preserved. This technique is applicable in certain anomalies of ventriculoarterial connection with ventricular septal defect and subpulmonary stenosis. The main advantage of this modification, besides preservation of growth potential of the translocated pulmonary artery, consists of preservation of pulmonary valve function, which may have a beneficial effect on the long-term preservation of right ventricular compliance.

Key words Lecompte operation • Pulmonary valve • Ventricular septal defect • Subpulmonary stenosis • Transposition of the great arteries

Introduction
A classic Rastelli [10] or Lecompte [6] operation (réparation à l’étage ventriculaire) are attractive management options in patients with anomalies of ventriculoarterial connection associated with ventricular septal defect (VSD) and pulmonary outflow tract obstruction. The Lecompte operation has the advantage that it obviates the need for an extracardiac prosthetic conduit for reconstruction of the pulmonary outflow tract with the need for subsequent reoperation. Because of concern with this technique regarding the absence of a pulmonary valve in the neo-pulmonary outflow tract we propose a modification of the Lecompte operation in which the pulmonary valve is preserved.

Operative technique
A median sternotomy is performed and a generous piece of pericardium is harvested and prepared in 0.625% glutaraldehyde solution. The aorta, the main pulmonary artery and its branches are mobilized as far peripherally as possible. After cardiopulmonary bypass has been established, the aorta has been cross-clamped and cold cardioplegia has been administered, a preliminary examination from the right atrium is performed. A right ventriculotomy is made. The aorta is transected well above the commissures (Fig. 1). Subsequently, the pulmonary root is dissected and detached from the left ventricle using low-energy electrocautery (Fig. 2). Great care must be taken to avoid damage to the coronary arteries (in particular the left main, circumflex, and proximal right coronary arteries) and the mitral valve. The conal septum between the VSD and great arteries is resected, taking great care to keep the excision away from the regions occupied by the His bundle and its primary branches. The leaflets of the aortic valve must be visualized so as to protect them from damage in the course of the resection. When tricuspid chordae tendineae are attached to a portion of the infundibular or ventricular septum, this portion can be raised as a flap with the chordae attached. After completion of the intraventricular repair, the flap is sutured to the roof of the tunnel, more-or-less in its original position. The intraventricular tunnel repair is performed by suturing in place a collagen-impregnated knitted Dacron baffle (Hemashield), to form the roof of the left ventricular-aortic pathway. The defect in the left ventricle is closed with a Hemashield patch using running 5-0 polypropylene suture (Prolene 3). The main pulmonary artery and its confluence is transected anterior to the aorta and the latter is reconstructed with 5-0 polyglyconate suture (Maxon 2). The posterior segment of the pulmonary annulus is anastomosed to the cephalad margin of the right ventriculotomy using 5-0 Maxon suture in a running fashion. The right ventriculo-pulmonary pathway is completed by suturing into place a roof of glutaraldehyde-treated autogenous pericardial patch or pulmonary homograft patch using 5-0 Prolene suture.

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Fig. 1 Lecompte operation with preservation of pulmonary valve in heart with transposition of the great arteries, ventricular septal defect, and subpulmonary stenosis. The dotted line represents the level of transection of the ascending aorta.

Fig. 2 After dissection of the pulmonary root and detachment of the latter from the left ventricle, an intraventricular Hemashield baffle is constructed in such a fashion that the left ventricle is connected with the aortic valve orifice. The defect in the left ventricle is closed with a Hemashield patch. The main pulmonary artery and its confluence are translocated anterior to the ascending aorta; the latter is reconstructed.

Fig. 3 The posterior segment of the pulmonary annulus is anastomosed to the cephalad margin of the right ventriculotomy; the residual defect is covered with a glutaraldehyde-treated autogenous pericardial patch or a pulmonary homograft patch.

This technique was successfully applied in two infants (both males, aged 1 and 3 months) with transposition of the great arteries, VSD, and severe subpulmonary stenosis (left ventricular-main pulmonary artery gradients of 50 and 60 mmHg, respectively). In both cases the postoperative course was uneventful, in particular there was no evidence of left or right ventricular outflow tract obstruction, myocardial ischemia, and aortic, pulmonary or mitral regurgitation. At 7 and 9 months follow-up, two-dimensional echocardiography documented an increase in the diameter of the main pulmonary artery in both patients (2 and 3 mm, respectively).

Discussion

The Lecompte operation, by extensive resection of the conal septum and reconstruction of right ventricular-pulmonary arterial continuity without prosthetic conduit, provides complete physiologic recovery in most anomalies of ventriculooarterial connection, VSD and pulmonary outflow tract obstruction. Therefore, it has the potential to overcome the limitations of the classic Rastelli procedure, namely it may decrease the need for reoperation, based on a lower rate of development of subaortic stenosis and avoidance of replacement of the right ventricle-to-main pulmonary artery conduit [1, 2, 6, 7, 9-12, 21, 22]. Moreover, the Lecompte operation avoids the need for a palliative aortopulmonary shunt as it can be performed at early age. Abnormal attachment of tricuspid valve chordae on the conal septum (interposed between the VSD and the aortic orifice) can be successfully managed by mobilization of a flap of conal septum and subsequent reattachment on the left ventricular-aortic tunnel [2]. Based on these technical modifications, the Lecompte operation offers the possibility of physiologic repair to a greater number of patients than does the classic Rastelli repair.

In anomalies of ventriculooarterial connection, VSD and subpulmonary stenosis, two-dimensional echocardiography and cardiac catheterization provide essential information necessary for the planning of rational surgical management, i.e. biventricular repair (intraventricular rerouting or Lecompte (or Rastelli) operation) versus univentricular repair (Fontan operation) [4, 8, 12, 13]. In addition, meticulous intraoperative assessment of the underlying cardiac anatomy is necessary to determine the necessity and feasibility of the Lecompte operation. First, of utmost importance in this regard is the position of the VSD relative to the aortic valve orifice and the tricuspid-pulmonary valve annular distance [12]. A tricuspid-pulmonary distance greater than the aortic valve annulus is believed to indicate that conventional intraventricular rerouting from the VSD to the aortic outflow tract and preservation of native right ventricle-to-pulmonary arterial continuity is feasible [1, 7]. Generally, if the aorta is in a right posterior-oblique or right side-by-side position relative to the pulmonary artery, the tricuspid-pulmonary distance is suf-
sufficient for intraventricular rerouting [1, 13]. In contrast, if the aorta is either directly anterior or in a left anterior-oblique position, the tricuspid-pulmonary distance is insufficient for intraventricular rerouting [1], because the intracardiac tunnel would encroach upon the right ventricular outflow tract or would interfere with tricuspid valve function. In such situation it becomes necessary to close off the pulmonary valve orifice, have the left ventricular-aortic baffle traverse the latter space and construct an extracardiac right ventricular-pulmonary arterial conduit. In patients with the aorta in a right anterior-oblique position there is generally poor correlation between the great artery position and tricuspid-pulmonary distance [1, 13]. Second, the relative position of the great arteries is assessed, as this dictates the specific technique of pulmonary outflow tract reconstruction. For a Lecompte operation to be feasible, the main pulmonary artery and its confluence need to be translocated anterior to the aorta (Lecompte maneuver). When the great arteries are related directly anterior and posterior, the Lecompte maneuver is most effective. When the great arteries take up a more side-by-side relationship, the advantage of the Lecompte maneuver decreases, but it is probably still useful until the aorta is located in a plane posterior to the main pulmonary artery. It is not possible to establish a rule as to when to apply the Lecompte maneuver, because not only are the pulmonary arteries being translocated in an anteroposterior direction, but there is also translocation in a superoinferior plane onto the right ventricular free wall. The degree of superoinferior transfer necessary is determined by the degree of development of the right ventricular infundibulum and the epicardial course of the coronary arteries; the latter determines the location of the right ventriculotomy.

Anatomic contraindications to the Lecompte operation remain: the presence of a remote VSD, “Swiss cheese” VSDs, hypoplasia of one of the ventricles, anatomic features that preclude performance of a Lecompte maneuver and hypoplasia of the main pulmonary artery and/or its branches. In most of these situations a staged univentricular repair according to Fontan’s principle is indicated [3, 20].

Physiologically, the modified Lecompte operation may be regarded as an antipole of the Ross operation, as in the former the pulmonary valve is translocated from the systemic circulation into the pulmonary circulation, whereas in the latter the reverse effect is accomplished. A condition sine qua non for feasibility of the modified Lecompte operation as described here is that the main pulmonary artery and pulmonary valve are of adequate diameter. Advantages of this modification consist of preservation of the pulmonary valve, which may have a beneficial effect on preservation of right ventricular compliance that is already compromised by the right ventriculotomy (5), and, as in any native tissue repair, preservation of growth potential of the main pulmonary artery. A concomitant advantage of this modified technique is that the main pulmo-

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Fig. 4 Patterns of origin and proximal epicardial course of the coronary arteries in transposition of the great arteries (as seen by an observer looking from the pulmonary artery toward the aorta). In the vast majority of cases, the left main coronary artery (LCA) originates from the left hand (anterior) sinus and the left circumflex coronary artery (LCx) passes anterior to the pulmonary annulus. Less frequently, the LCx courses posterior to the pulmonary annulus. Rarely, the left anterior descending coronary artery (LAD) passes between the great arteries, thereby initially taking an aortic intramural course. Physiologically, the modified Lecompte operation may be regarded as an antipole of the Ross operation, as in the former the pulmonary valve is translocated from the systemic circulation into the pulmonary circulation, whereas in the latter the reverse effect is accomplished. A condition sine qua non for feasibility of the modified Lecompte operation as described here is that the main pulmonary artery and pulmonary valve are of adequate diameter. Advantages of this modification consist of preservation of the pulmonary valve, which may have a beneficial effect on preservation of right ventricular compliance that is already compromised by the right ventriculotomy (5), and, as in any native tissue repair, preservation of growth potential of the main pulmonary artery. A concomitant advantage of this modified technique is that the main pulmo-
As compared with the classic Lecompte operation, the modified operation as described here has an increased risk of damage to the coronary arteries and the mitral valve. In anomalies of ventriculoarterial connection, the spectrum of coronary arterial anatomy varies inherently with the spectrum of positional relationship of the great arteries. In the usual coronary artery pattern in transposition of the great arteries, with the right coronary artery arising from the right hand (posterior) sinus and the left main coronary artery arising from the left hand (anterior) sinus (as seen by an observer looking from the pulmonary artery toward the aorta [19]), the circumflex coronary artery usually courses anterior to the pulmonary artery in the atrioventricular sulcus (Fig. 4). Therefore, the left main, circumflex and proximal right coronary arteries are at risk for injury during the dissection of the pulmonary root. In other less common coronary artery patterns, the circumflex coronary artery may course posterior to the pulmonary artery, whereas the left anterior descending coronary artery may course posterior to the pulmonary artery. In the usual setting, however, the left ventricle lacks an infundibulum, there usually being pulmonary-mitrail fibrous continuity comparable to the aortic-mitrail continuity present in the normal heart. Therefore, great care must be taken to avoid injury to the mitral valve.

In summary, preliminary experience with the Lecompte operation with preservation of the pulmonary valve leads us to conclude that this modified technique is applicable in patients with anomalous ventriculoarterial connection, VSD and subpulmonary stenosis. The main advantage of this modified technique (as compared with the classic Rastelli operation), besides the reduced potential for development of subaortic obstruction and avoidance of replacement of the extracardiac conduit, consists of the increased likelihood of long-term preservation of right ventricular compliance. Further follow-up is necessary to study the long-term outcome of this modification.

References