Lecompte Procedure for Complete Transposition of the Great Arteries With Ventricular Septal Defect and Pulmonary Stenosis

Yong Jin Kim, MD, Hyun Song, MD, Jeong Ryul Lee, MD, Joon Ryang Rho, MD, and Kyung Phill Suh, MD

Department of Thoracic and Cardiovascular Surgery, College of Medicine, Seoul National University, Seoul, Korea

From December 1988 to February 1993, 19 patients were treated by the Lecompte procedure for complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis. The mean age at operation was 3.1 ± 0.8 years (mean ± standard error). This technique consisted of resecting the outlet septum, constructing a tunnel that connected the left ventricle to the aorta, closing the proximal pulmonary arterial stump, pulling the distal pulmonary artery down to the right ventriculotomy site directly, and covering anteriorly with the fixed autologous pericardium. Operative mortality was 5.3%. The mean follow-up was 24.2 ± 3 months, with no late death. One reoperation was performed because of residual right ventricular outflow tract obstruction. All survivors were studied by echocardiography at intervals of 6 months to 1 year. In all survivors (except for 1 child who underwent reoperation), the estimated pressure gradient between the right ventricle and the pulmonary artery, the structure of the left ventricular outflow tract, left ventricular function, and right ventricular contractility were all satisfactory.

(Ann Thorac Surg 1994;57:876–9)

The Rastelli procedure [1] has been considered the standard repair for complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis. This procedure has one of the weakest points of reconstructive operations for congenital heart disease, in that suitable homografts are not always available, and prosthetic conduits need to be replaced due to the growth of the patient and valve or conduit failure. In an effort to avoid this limitation, Lecompte and his colleagues [2] introduced a new surgical technique for the treatment of complete transposition of the great arteries associated with a ventricular septal defect and pulmonary outflow tract obstruction. They called this technique the REV (Réparation à l'Etage Ventriculare) procedure. Recently the REV procedure has been called the Lecompte procedure or operation [3, 4]. The basis of this technique is resection of the outlet (infundibular) septum, which enables construction of a shorter, more direct intraventricular tunnel. As a consequence, it is possible to reimplant the pulmonary trunk directly on the superior margin of the right ventricular infundibulotomy without a conduit. The purpose of this study is to review our overall experience with the Lecompte procedure for treatment of 19 patients with complete transposition of the great arteries associated with a ventricular septal defect and pulmonary outflow tract obstruction.

Accepted for publication July 15, 1993.

Address reprint requests to Dr Kim, Department of Thoracic and Cardiovascular Surgery, Seoul National University Hospital, 28, Yongon-Dong, Chongno-Gu, Seoul 110-744, Korea.

Material and Methods

Patients

From December 1988 to February 1992, 19 patients underwent the Lecompte procedure for complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis. The patients' age at operation ranged from 7 months to 16 years (mean ± standard error, 36.8 ± 9.7 months; median, 23.0 months). All patients were less than 5 years of age, except 1. Three patients (15.8%) were less than 1 year of age. Eleven patients were male, and 8 were female. Weight at operation ranged from 6.6 to 40 kg (mean ± standard error, 12.0 ± 1.7 kg; median, 9.9 kg). Ten patients (52.6%) weighed less than 10 kg. The mean hemoglobin concentration was 15.9 ± 0.7 g/100 mL. Preoperative mean pulmonary artery index (Nakata index) was 291 ± 20 mm^2/m^2. Associated anomalies were patent ductus arteriosus (68.4%), atrial septal defect (26.3%), bilateral superior vena cava (21.1%), juxtaposed atrial appendage (21.1%), dextrocardia (5.3%), and right aortic arch (5.3%). Four patients (21.1%) had previous modified Blalock-Taussig shunt. All the ventricular septal defects were the perimembranous type. In 2 patients, the great arteries were side by side, while the others had the usual anteroposterior relationship. One patient had abnormal insertion of the tricuspid tension apparatus on the outlet septum.

Surgical Technique

A median sternotomy was performed. Cardiopulmonary bypass was established, with systemic hypothermia to 28°C. In 2 patients, we used the technique of total circulatory arrest and deep hypothermia. The branches of the

0003-4975/94/$7.00

pulmonary artery were dissected sufficiently beyond the pericardial reflection. Previous shunts were taken down before running cardiopulmonary bypass. After aortic cross-clamping, a vertical incision was made on the right ventricle just beneath the aorta. The pulmonary artery was transected at the level of the commissures, and the proximal pulmonary arterial stump was closed. After the intracardiac anatomy was assessed, the outlet septum (conal septum) was fully resected to create a large communication between the left ventricle and the aorta. This resection enlarges even a small restrictive ventricular septal defect and constructs a rather straight left ventricular outflow tract. The length and width of the channel from the left ventricle to the aorta was measured and a patch was tailored. The sutures began at the lower corner of the ventricular septal defect near the tricuspid valve, where we were careful not to injure the conduction tissue. The sutures were run around the right and anterior parts of the aortic orifice. At this point, it is important to determine the size of the patch so as not to jeopardize both ventricular outflow tracts. In 1 patient, we found that the medial papillary muscle of the tricuspid valve was attached to the infundibular septum. We transferred this abnormally inserted papillary muscle to the patch.

In the next step, the pulmonary artery was pulled down to the superior margin of the right ventriculotomy, without resection of the ascending aorta. This was possible when we dissected the branches of the pulmonary artery sufficiently to the level of the pericardial portions. The pulmonary bifurcation was always located posterior to the ascending aorta. Depending on the initial position of the great arteries, the pulmonary artery was placed either on the left side of the aorta (16 patients) or on its right side (3 patients). The pulmonary arterial trunk was then incised longitudinally on its anterior aspect and directly anastomosed to the upper part of the ventricular incision with absorbable suture material. This native pulmonary tissue thus formed the posterior wall of the neo-pulmonary trunk. If this direct anastomosis caused tension, we extended the pulmonary artery incision more distally. Finally, the lower part of the ventricular incision and the anterior aspect of the pulmonary arterial trunk were covered with a glutaraldehyde-fixed autologous pericardium. A monocusp valve was inserted along the margin of the ventricular incision using the autologous pericardum, which was also fixed.

Results

One patient (5.3%) died 13 days after the operation. The cause of death was low cardiac output due to right ventricular failure. There was no late death. One of the 18 survivors was lost to follow-up, which yielded a 94.4% complete follow-up. The mean follow-up was 24.2 ± 3.3 months. The cardiopulmonary bypass time was 156 ± 6.7 minutes, and the aortic cross-clamp time was 69.4 ± 3.1 minutes.

Postoperative complications developed in 6 patients (Table 1). Three patients had surgical bleeding. Two patients had minor wound problems. One patient had postoperative transient atrioventricular block but returned to sinus rhythm 1 week later. In 1 patient cortical blindness developed related to an air embolism.

Table 1. Postoperative Complications (n = 19)

Postoperative Complication	Total Number	Percent
Surgical bleeding	3	15.8
Wound dehiscence	2	10.6
Transient atrioventricular block	1	5.3
Cortical blindness	1	5.3

One patient, who had had a severe proximal stenosis of the left pulmonary artery at the time of the initial diagnosis, required reoperation 19 months later due to severe stenosis of the left pulmonary artery origin. The pulmonary outflow tract was reconstructed with bovine pericardium.

All survivors were studied by Doppler echocardiography within 1 month. Except for 1 patient, none had a significant pressure gradient (over 30 mm Hg) between the right ventricle and neo-pulmonary artery. The estimated pressure gradient of this patient was 36 mm Hg. In all patients, the structure of the left ventricular outflow tract was satisfactory, and left ventricular function (assessed by the shortening fraction of the left ventricular axis) was good. Even though right ventricular assessment was difficult because of the lack of standardized criteria of size and function in the presence of pulmonary regurgitation, the right ventricular contractility was well preserved in all survivors. Residual ventricular septal defect was detected in 2 patients, but the shunt was not significant. Significant pulmonary regurgitation was not detected in any survivor.

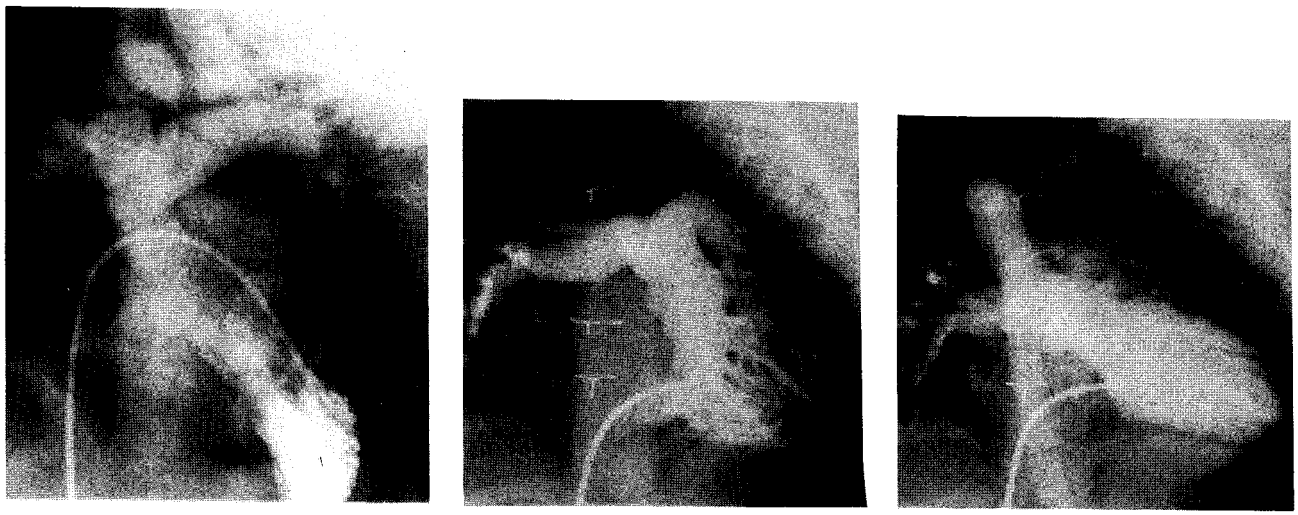
All survivors were restudied by echocardiography at an interval of 6 months or 1 year. There was no difference compared with the first echocardiographic examination except in the child who underwent reoperation. This reoperated patient had poor right ventricular contractility and severe pulmonary regurgitation.

Apart from the child who underwent reoperation, we recatheterized the first 4 patients with the consent of parents 1 year postoperatively. Pressure gradients between the right ventricle and pulmonary artery were less than 30 mm Hg and the pressure ratios between right ventricle and left ventricle were less than 0.5 in all patients. In 1 patient, residual shunt was found, but the amount of the shunt was not significant (pulmonary/systemic flow ≤ 1.5). Angiographically there was no focal narrowing and no flow disturbance on the right ventricular outflow tract (Figs 1, 2).

Comment

Until now, the Rastelli procedure [1] has been considered the treatment of choice for complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis. The Rastelli procedure does

Ann Thorac Surg
1994;57:876–9

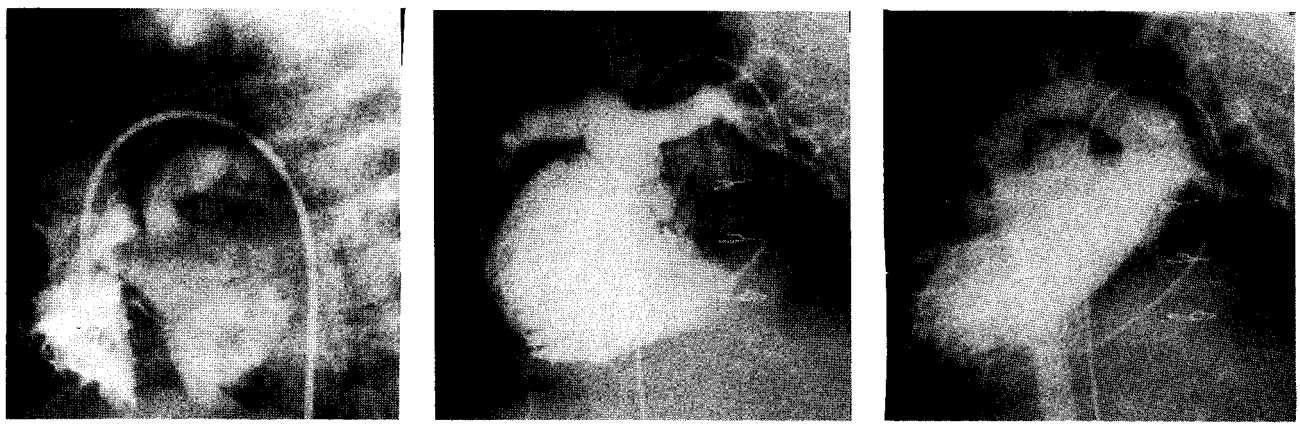


A B C

Fig 1. Angiogram before and 1 year after repair in a female patient who had been operated on at 11 months of age. (A) Preoperative left ventriculogram in four-chamber view. (B, C) postoperative right ventriculogram and its levophase in frontal view.

have some limitations. First, it is not feasible in some patients with inadequate ventricular defect size or atrioventricular valve interposition between the ventricular septal defect and aortic orifice [5]. Second, extracardiac conduits are usually deferred when a relatively large conduit can be used. Third, prosthetic conduits need to be replaced due to growth of the patient, and to valve or conduit failure. Fourth, homografts are not always available due to limited supply. For these reasons, Lecompte and his colleagues [2] proposed the REV procedure. The principles of this technique were resection of the outlet (infundibular) septum, construction of a tunnel connecting the left ventricle to the aorta, and direct anastomosis of the pulmonary arterial trunk without prosthetic conduit.

Recently Lecompte [6] reviewed 50 patients who were treated by the Lecompte procedure (REV procedure) for the repair of complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis. In his procedure, the pulmonary bifurcation was usually placed anterior to the ascending aorta (the so-called Lecompte maneuver [7]), and some part of the ascending aorta was resected so as to create enough space in the anterior mediastinum for the pulmonary outflow tract. He applied the Lecompte maneuver to 44 of 50 patients, when the great arteries were more or less anteroposterior and not side by side. We did not apply the Lecompte maneuver in any patient. Even when the great arteries had an anteroposterior relationship, it was not difficult to pull the pulmonary artery down to the right ventriculotomy site without tension. This was accomplished by sufficient dissection of the pulmonary arterial branches and sometimes by wide pulmonary artery incision.



A B C

Fig 2. Angiogram before and 1 year after repair in a situs inversus female patient who had been operated on at 9 months of age. (A) Preoperative right ventriculogram in lateral view. (B, C) Postoperative right ventriculogram and its levophase in right anterior oblique view.

We encountered 1 patient whose papillary muscle of the tricuspid valve was attached to the infundibular septum. Borromée and associates [8] recommended a "flap" technique in such cases. The infundibular septum was not resected but mobilized with two incisions, one anterior and the other subaortic. We transferred abnormal papillary muscle to the patch because this was the anatomic position that did not cause valve incompetence. Tricuspid valve regurgitation has not developed in this patient during a 1 year follow-up period, but we are conducting long-term follow-up because of the possibility of tricuspid valve incompetence.

Pulmonary regurgitation is well tolerated after reconstruction of the right ventricular outflow tract for tetralogy of Fallot when there is no residual right ventricular outflow tract obstruction. In all cases, we placed a monocusp valve along the lower margin of the ventricular incision by attaching a piece of glutaraldehyde-fixed autologous pericardium. We expected this valve to give immediate postoperative functional improvement.

The long-term fate of the reconstructed right ventricular outflow tract in the Lecompte procedure may be similar to that of a repaired tetralogy of Fallot if the posterior wall of the neopulmonary artery grows. Vouhé and colleagues [4] compared the Lecompte procedure with Rastelli's procedure. The likelihood of reoperation for pulmonary outflow obstruction was significantly higher in the Rastelli group (67%) than in the Lecompte procedure group (26%) during a 10-year period. Although further experience is necessary, the Lecompte procedure may have a potential for growth of the pulmonary outflow tract.

Recently Sano and colleagues [9] showed excellent results with extracardiac valved conduits in the pulmonic position. They reported six hospital deaths (3.6%) and seven late deaths (4.1%) in a total of 169 conduit insertions during a 10-year period. Among these conduit insertions, 46 were in patients less than 1 year of age. Actuarial freedom from conduit replacement for long-term survivors was 37% at 5 years. There is no ideal conduit for use in small children, because conduits invariably need to be replaced sometime. The Lecompte procedure can be performed in smaller children than the Rastelli procedure because of its avoidance of an extracardiac conduit and because of the potential growth of the right ventricular outflow tract. This procedure provides early functional recovery in childhood and avoids the need for a palliative shunt.

The Lecompte procedure is currently our operation of choice for patients with complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis. In our hospital, during the same period (from December 1988 to February 1993), only 3 patients underwent the Rastelli procedure for the same disease. Among these 3 patients, 1 patient had previously undergone the pulmonary artery banding procedure and 1 patient had undergone ligation of the major aortopulmonary collateral arteries. It was not feasible to dissect the branches of the pulmonary artery extensively in these 2 patients.

In conclusion, most patients with complete transposition of the great arteries associated with a ventricular septal defect and pulmonary stenosis could be managed successfully with the Lecompte procedure. The Lecompte procedure may allow early, complete anatomic correction, and reduce the need for late reoperation. Our experience remains limited, however, and further follow-up is mandatory.

References

1. Rastelli GC, McGoon DC, Wallace RB. Anatomic correction of transposition of the great arteries with ventricular septal defect and subpulmonary stenosis. J Thorac Cardiovasc Surg 1969;58:545–52.
2. Lecompte Y, Neveux JY, Leca F, et al. Reconstruction of the pulmonary outflow tract without prosthetic conduit. J Thorac Cardiovasc Surg 1982;84:727–33.
3. Kirklin JW, Barratt-Boyes BG. Cardiac surgery. New York: Churchill Livingstone, 1993:1486–92.
4. Vouhé PR, Tamisier D, Leca F, Ouaknine R, Vernant F, Neveux JY. Transposition of the great arteries, ventricular septal defect, and pulmonary outflow tract obstruction. Rastelli or Lecompte procedure? J Thorac Cardiovasc Surg 1992; 103:428–36.
5. Villagra F, Quero-Jimenez M, Maitre-Azcarate MJ, Gutierrez J, Brito JM. Transposition of the great arteries with ventricular septal defects. Surgical considerations concerning the Rastelli operation. J Thorac Cardiovasc Surg 1984;88:1004–11.
6. Lecompte Y. Réparation à l'etage ventriculaire—the REV procedure: technique and clinical results. Cardiol Young 1991;1: 63–70.
7. Lecompte Y, Zannini L, Hazan E, et al. Anatomic correction of transposition of the great arteries: New technique without use of a prosthetic conduit. J Thorac Cardiovasc Surg 1981;82: 629–31.
8. Borromée L, Lecompte Y, Batisse A, et al. Anatomic repair of anomalies of ventriculoarterial connection associated with ventricular septal defect. II. Clinical results in 50 patients with pulmonary outflow tract obstruction. J Thorac Cardiovasc Surg 1988;95:96–102.
9. Sano S, Karl TR, Mee RBB. Extracardiac valved conduits in the pulmonary circuit. Ann Thorac Surg 1991;52:285–90.