

# New technique: aortic and pulmonary translocation with preservation of pulmonary valve

*Nova técnica: translocação aórtica e pulmonar com preservação da valva pulmonar*

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## Resumo

Realizamos com sucesso novo procedimento cirúrgico, em duas crianças portadoras de transposição das grandes artérias associada a comunicação interventricular e obstrução da via de saída do ventrículo esquerdo. A cirurgia consiste na realização de translocação aórtica com a valva aórtica e as artérias coronárias para o ventrículo esquerdo, após a ampliação da via de saída desse ventrículo e da comunicação interventricular com pericárdio autólogo fixado em glutaraldeído, associada à translocação do tronco pulmonar para o ventrículo direito, conservando integralmente a valva pulmonar.

**Descritores:** Transposição dos grandes vasos/cirurgia. Cardiopatias congênicas/cirurgia. Defeitos do septo interventricular. Estenose da valva pulmonar.

## Abstract

We applied successfully, a new surgical technique, in two children with transposition of the great arteries with ventricular septal defect and left ventricular outflow tract obstruction, that utilized aortic translocation with the aortic valve and the coronary arteries to the left ventricle, after correction of left outflow tract obstruction and correction of the ventricular septal defect, associated to pulmonary root translocation to the right ventricle, conserving integrally the pulmonary valve.

**Descriptors:** Transposition of great vessels/surgery. Congenital heart defects/surgery. Heart septal defects, ventricular. Pulmonary valve stenosis.

## INTRODUCTION

There are several techniques to correct transposition of the great arteries (TGA) with ventricular septal defect (VSD) and left ventricular outflow tract obstruction (LVOTO). In the Rastelli procedure [1], left ventricle (LV) tunneling obstruction can occur towards the aorta through the right ventricle (RV) as well as dysfunction of the valved conduit placed in the right ventricle outflow tract (RVOT).

The Lecompte operation or “reparation al’etage ventriculaire” [2], which consists of infundibular septum resection and RVOT reconstruction with translocation of the pulmonary artery without pulmonary valve; it may also evolve with RV dysfunction. Nikaidoh [3] proposed the performance of aortic translocation with the aortic valve and coronary arteries to the LV, after an expansion of the LVOT and closure of IVC is performed; the aorta was properly positioned in the LVOT. In this correction, the

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This study was carried out at Instituto Furlanetto (OSCIP VIDA-CORAÇÃO-CRIANÇA) Real e Benemérita Associação Portuguesa de Beneficência, São Paulo, SP, Brazil.

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RVOT is reconstructed with the translocation to the RV from the pulmonary trunk also without the pulmonary valve and progressing with RV impairment as well.

The translocation of the pulmonary trunk with preservation of pulmonary valve and aorto-LV tunneling through RVOT was performed by Silva et al. [4].

This surgery does not eliminate the disadvantage of aorto-LV tunneling through RVOT, but it has the advantage of preserving the pulmonary valve. Hu et al. [5] performed the aortic translocation to LV with the aortic valve and coronary arteries as well as RVOT reconstruction with enlargement of the pulmonary valve with bovine jugular vein monocuspid valve.

This procedure anatomically corrects LVOT, but it will show monocuspid dysfunction thereafter. We believe that performing pulmonary and aortic translocation with preservation of pulmonary valve (PAT-PVP) and correction of both LVOT obstruction and IVC could have advantages over other techniques used so far.

#### SURGICAL TECHNIQUE

The present study was approved by the Research and Ethics Committee of Hospital São Joaquim da Real e Benemérita Associação Portuguesa de Beneficência.

Cardiopulmonary bypass (CPB) with hypothermia at 25°C and myocardial protection with hypothermic blood cardioplegic solution at a proportion of 3:1 was performed as well as modified ultrafiltration. Initially, an incision inferior to the aortic valve was made, removing the RV from the ascending aorta along with aortic valve and coronary arteries. Following, in order to excise from the LV the

pulmonary trunk along with the pulmonary valve, an incision was made inferior to the pulmonary valve (Figure 1).

After the infundibular septum was sectioned up to IVC, LVOT was expanded and CIV was closed with a single glutaraldehyde-fixed bovine pericardium graft (Figure 2). After the aortic translocation was removed, the resulting opening was partially closed with a fresh autologous pericardial patch. Finally, the aortic translocation with the aortic valve and coronary arteries was sutured to the LVOT, and the pulmonary trunk with the pulmonary valve was sutured to the RVOT (Figure 3).

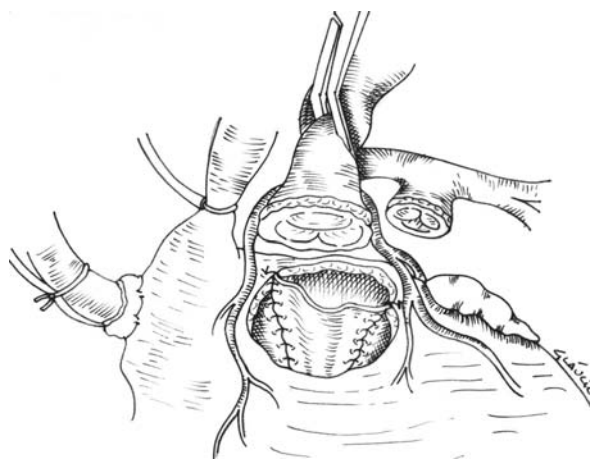


Fig. 2 – After section of the pulmonary ring and infundibular septum toward the interventricular communication, an enlargement of the left ventricle outflow tract and a closure of interventricular communication was carried out using a glutaraldehyde-fixed bovine pericardium graft

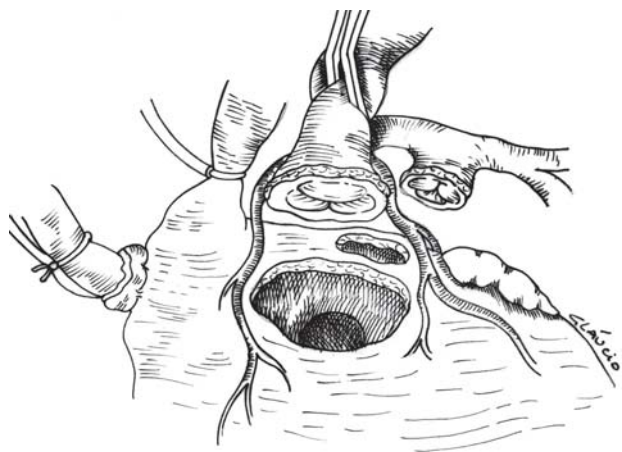


Fig. 1 – Withdrawal of the ascending aorta with the aortic valve and coronary arteries from the right ventricle and removal of the pulmonary trunk with the pulmonary valve from the left ventricle

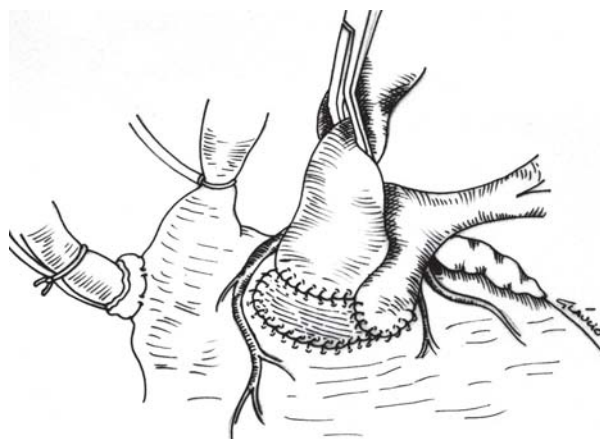


Fig. 3 – The resulting opening from resection of the ascending aorta was partially closed to the right with a fresh autologous pericardial patch. The ascending aorta with the coronary arteries and the aortic valve was sutured to the left ventricle outflow tract and the pulmonary trunk with the pulmonary valve was sutured to the right ventricle outflow tract

## RESULTS

Two children with TGA with perimembranous IVC and LVOT type-fibromuscular tubular obstruction associated to hypoplasia of the pulmonary valve ring underwent PAT-PVP.

### Patient 1

Female child, aged two years, weighing 10.8 kg underwent two previous Blalock-Taussig shunt surgeries. Preoperative color Doppler echocardiography revealed a LVOT gradient of 40 mmHg. CPB time was 195 minutes and the aortic clamping time was 123 minutes. Pressure measurement after surgical correction revealed a ratio of systolic pressure between the RV and LV (RV/LV) of 0.6 and a pulmonary gradient of 25 mmHg. The postoperative Doppler echocardiography revealed mild central aortic regurgitation and a pulmonary transvalvular gradient of 42 mmHg.

### Patient 2

Male child, aged 6 months, weighing 7.3 kg. Preoperative Doppler echocardiography revealed LVOT gradient of 65 mmHg. CPB time was 184 minutes and aortic clamping time was 140 minutes. Pressure measurement after surgical correction revealed RV/LV systolic pressure of 0.8 and pulmonary transvalvular gradient of 30 mmHg. Postoperative Doppler echocardiography revealed mild central regurgitation of the aortic valve and a pulmonary transvalvular gradient of 31 mmHg.

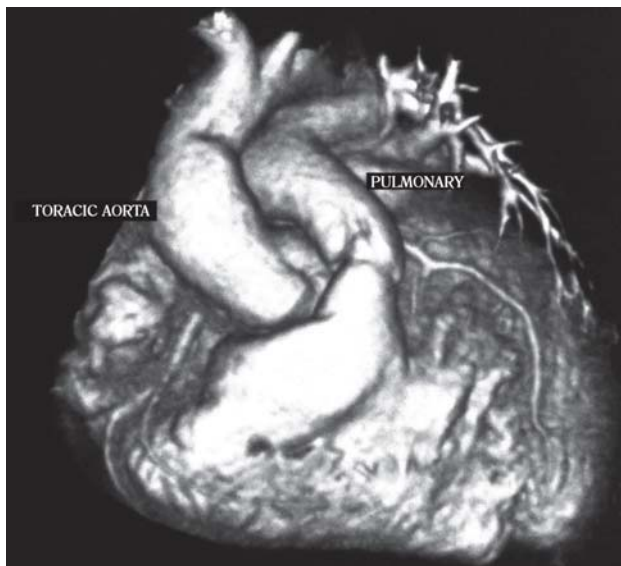


Fig. 4 – CT angiography performed in the immediate postoperative period showed appropriate positioning of the pulmonary artery and pulmonary branches as well as the aortic trunk

Heart CT angiography performed during the immediate postoperative period showed appropriate positioning of the pulmonary trunk, pulmonary artery and aorta in both patients (Figure 4).

## DISCUSSION

Up to the present moment, no surgical procedure for correction of TGA with IVC and LVOT obstruction fully preserves the aortic and pulmonary valves and anatomically corrects RVOT and LVOT. Aorto-LV tunneling using RVOT can cause obstruction. LV aortic translocation after enlargement of LVOT and IVC closure may avoid this complication. The use of prosthetic valves in a pulmonary position, in children, develops early dysfunction and the absence of the pulmonary valve causes RV dysfunction. Based on this fact, a RVOT mild to moderate residual gradient has been accepted in the correction of tetralogy of Fallot by Voges et al. [6], who admits a ring size of the pulmonary valve with z-score of up to -4. In both children who underwent PAT-PVP, a pulmonary transvalvular gradient was observed as a consequence of pulmonary preservation with annular hypoplasia.

The enlargement of left ventricle outflow tract and the closure of interventricular communication with a single flap must be compatible with the aortic annulus, without distorting the aortic valve.

In PAT-PVP, coronary arteries may need to be relocated when their translocation along with the ascending aorta is not possible.

Pulmonary PAT-PVP differs from all other techniques used so far, because it corrects LVOTO through the aortic translocation with aortic valve and coronary arteries to the LV after LVOT enlargement and IVC closure; it also corrects RVOT through the translocation of the pulmonary trunk with an intact pulmonary valve to RV.

We believe this procedure can be performed even when the pulmonary valve has mild annular hypoplasia.

A late follow-up of a larger series of children will be important to check the potential development of the pulmonary valve.

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