Modified Nikaidoh Procedure for Transposition of Great Arteries, Ventricular Septal Defect and Left Ventricular Outflow Tract Obstruction

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Abstract

The surgical management of transposition of the great arteries with ventricular septal defect and left ventricle outflow tract obstruction is a real challenge in congenital heart surgery. The Rastelli operation has been used for many years with satisfactory early and late results. A newer operation described by Nikaidoh seems to take anatomy more into account and has been performed with promising outcomes. In this report, we present a patient with transposition of the great arteries, ventricular septal defect and left ventricular outflow tract obstruction who was successfully treated with a modification of the Nikaidoh procedure.

Key words
Transposition of great arteries · ventricular septal defect · left ventricular outflow tract · Rastelli procedure · Nikaidoh procedure

Introduction

Transposition of the great arteries (TGA) with ventricular septal defect (VSD) and left ventricular outflow tract (LVOT) obstruction represents 0.67% of all congenital heart defects [1]. The surgical management of this pathology is a real challenge. The Rastelli procedure has been used as a first choice of correction in many cases with satisfactory early and late results [2]. In 1984, Nikaidoh first described a new surgical approach for the correction of this pathology. The approach consisted of an aortic translocation without coronary transfer with biventricular outflow tract reconstruction [3].

In this report, we present a patient with TGA-VSD-LVOT obstruction who was successfully treated with a modified Nikaidoh procedure.

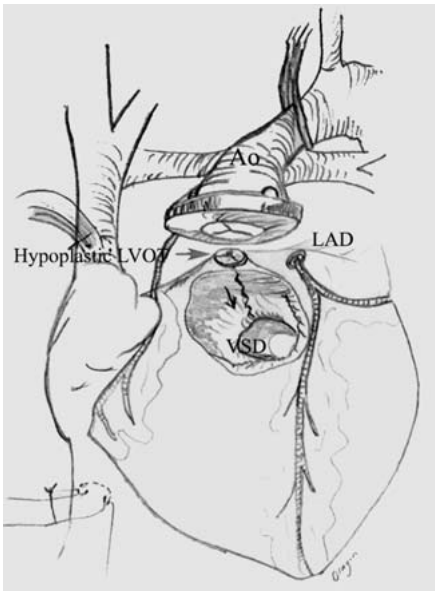

Fig. **1** Right ventricular outflow tract and mobilization of the aortic root without the LMCA (LVOT: left ventricular outflow tract; Ao: aorta; VSD: ventricular septal defect).

Case Report

A 3.5-year-old cyanotic child was referred to our clinic with the diagnosis of TGA-VSD-LVOT obstruction. He had undergone right and left modified Blalock-Taussig shunt operations when he was 1 month and 2.5 years old, respectively. The cardiac catheterization revealed a restrictive VSD with LVOT obstruction and normal coronary arteries.

The operation was performed through median sternotomy under low flow cardiopulmonary bypass (CPB) at moderate hypothermia (25 °C). Myocardial protection was achieved with antegrade cold crystalloid cardioplegia and topical ice slush. High aortic and bicaval cannulation was performed. As soon as CBP was initiated, both shunts were legated. After cross-clamping, the proximal one-centimeter segments of the right coronary artery (RCA) and left main coronary artery (LMCA) were extensively prepared and mobilized. The LMCA button was detached from the aorta and the defect was patched with pericardial tissue. The aortic root was completely dissected with a 5-mm cuff from the right ventricular outflow, together with the RCA still attached to it (Fig. **1**). After that, the main pulmonary artery was dissected above the pulmonary valves and the dysplastic valves were excised. The LVOT was enlarged by dissecting the infundibular septum down to the restrictive VSD. The hypertrophic muscles on the left side of the ventricular septum were resected. A glutaraldehyde fixed pericardial patch was used to create an inferior bor-

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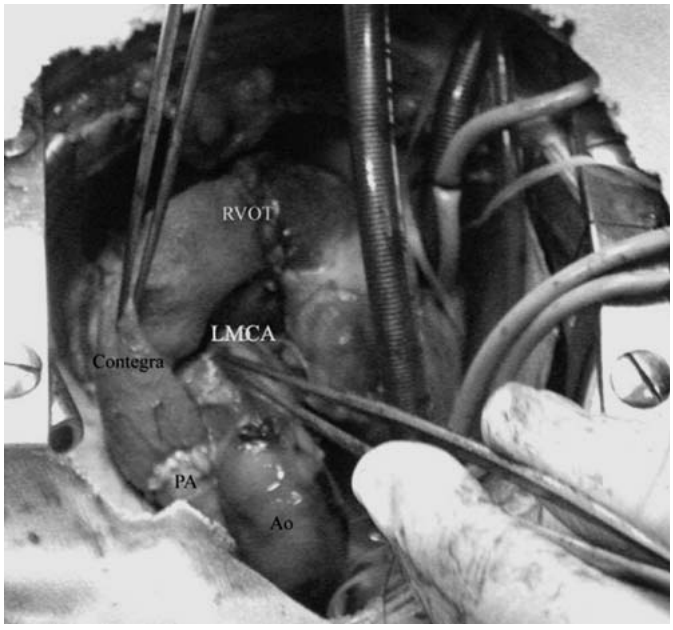

Fig. **2** Perioperative view of the completed aortic translocation and right ventricular outflow tract reconstruction. (RVOT: right ventricular outflow tract; Ao: aorta; PA: pulmonary artery; LMCA: left main coronary artery).

der by running 5.0-polyprolene sutures. The patch was placed from the lower border of the VSD up to the outflow tract. The aortic root, together with the RCA, was translocated completely to the new outflow tract by interrupted pledgeted 5.0 polyprolene sutures. After reconstruction of the new LVOT, the cross-clamp was removed. As the aorta was filled with blood, the appropriate location for the LAD button on the anterior of the aorta was marked and recross-clamped. The marked location opened with a 4.0 punch and the LMCA was anastomosed to the aorta. The posterior surface of the right ventricular outflow tract (RVOT), anterior to the aorta, was reinforced with a circular pericardial collar in order to facilitate the reconstruction of the RVOT by anastomosis using an 18-mm Contegra conduit. The Lecompte maneuver was not performed (Fig. **2**). The patient was weaned off CPB with low-dose inotropic support and was in sinus rhythm. CPB and aortic cross-clamp times were 156 minutes and 110 minutes, respectively. The patient was extubated six hours after the operation. The postoperative course was uneventful and he was discharged from the hospital on the 12th postoperative day.

The patient is still doing very well nine months after the operation. Control echocardiography showed successful correction of the pathology without any gradient between the outflow tracts, and with only mild mitral regurgitation. Control computerized tomography revealed normal positioning of the LVOT and RVOT.

Discussion

TGA with VSD and LVOT obstruction is a rare and complex morphology among the congenital heart diseases. The surgical management of this pathology has been a real challenge. Even though the Rastelli operation seems to be the best choice for this pathology, difficult anatomical morphologies, such as restrictive VSD or straddling AV valves, may complicate this operation. Besides, the long-term results of the Rastelli operation, especially left ventricular dysfunction and arrhythmia, may lead to unexpected late mortality [2,4]; thus, in recent years, this has made cardiac surgeons more wary of carrying out a Rastelli procedure.

The procedure used and amended here is an aortic translocation together with biventricular outflow tract reconstruction and was first described by Nikoidoh in 1984. This seems to take anatomical structures into account better in the correction of TGA-VSD-LVOT obstruction. However, there are only two large series of this procedure in the literature. The first one was by Nikaidoh, and, in his presentation, he explains his original technique of mobilization of the aortic root without detaching the coronary arteries. In his series, only four of seventeen patients were able to undergo complete translocation. Three of them required postoperative extracorporeal membrane oxygenation support. [5]. Most probably, the coronary ischemia was the primary reason for the early support [1].

The second report is from Morell et al. In their technique, the coronary arteries were devised from the aorta subsequent to aortic translocation; coronary transfers were performed in order to prevent coronary insufficiency. With their technique, coronary anomalies were found to be the major risk factor [1]. In contrast to the experience of Morell and coworkers, coronary anomalies are not a major risk factor for the Rastelli procedure.

Harvesting the aortic root, together with the coronary arteries, may lead to kinking and coronary ischemia. In our single experience, complete transfer of the aortic root without any postoperative ischemic events was probably mediated by extensive preparation and mobilization of the proximal segments of the RCA and detachment of the LMCA. Furthermore, the sufficiently long xenograft for the RVOT reconstruction did not require a Lecompte maneuver. Compared with the necessity for reoperations after Rastelli procedures, we believe that with our technique the anatomical placement of the valve conduit will remain stress-free under the sternum and will remain durable for a longer period of time.

In conclusion, aortic translocation and biventricular outflow tract reconstruction results in an exact anatomical correction for patients with TGA-VSD-LVOT obstruction. The left ventricle aorta and right ventricle-pulmonary artery alignment offer the best subsequent cardiac performance. Although the Rastelli procedure is still the operation of choice for most surgeons for this pathology, patients who have additional anatomical problems, such as restrictive or inlet VSD, or straddling AV valve obstruction, may be corrected using the original Nikaidoh operation or modifications of this procedure. We believe this operation will offer promising results in the future.

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