

Modified Nikaidoh Operation in a Patient with Dextro-Transposition of the Great Arteries, Ventricular Septal Defect, and Left Ventricular Outflow Tract Obstruction

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ABSTRACT

The optimal surgical management for patients with transposition of the great arteries (TGA), ventricular septal defect (VSD) and left ventricular outflow tract obstruction (LVOTO) remains controversial. We describe the case of a patient with TGA, a remote restrictive VSD, and LVOTO who underwent a successful modified Nikaidoh operation.

INTRODUCTION

The optimal surgical management for patients with transposition of the great arteries (TGA), ventricular septal defect (VSD), and left ventricular outflow tract obstruction (LVOTO) is a source of debate among surgeons. Different surgical techniques, including the Rastelli procedure, the *réparation à l'étage ventriculaire* (REV) operation, the Metras modification, and the Nikaidoh operation were introduced for the surgical treatment of this particular entity [Nikaidoh 1984; Morell 2005; Bautista 2007; Yeh 2007; Hu 2008; Hazekamp 2010]. The long-term results of the Rastelli procedure, along with those for the REV operation and the Metras modification, have been less than optimal [Nikaidoh 1984; Morell 2005; Bautista 2007; Yeh 2007; Hu 2008; Hazekamp 2010]. In 1984, Nikaidoh described a new surgical technique that allows a repair that is closer to the normal anatomy, which he called "aortic translocation and biventricular outflow tract reconstruction" [Nikaidoh 1984]. Although the experience with this operation lacks large numbers of patients and long-term follow-up data, the early results have been encouraging [Morell 2005; Hu 2008]. In this report, we present the case of a patient with TGA, a remote restrictive VSD, and LVOTO who successfully underwent a modified Nikaidoh operation.

CASE REPORT

The patient was an 18-month-old male infant weighing 9.5 kg. A preoperative echocardiogram revealed TGA, a VSD, and a severe LVOTO. The LVOTO was at the subvalvular and valvular level, with a gradient of 60 mm Hg. The VSD was subpulmonary, with a diameter of 9 mm. In light of these findings, we decided to perform a modified Nikaidoh operation.

Surgical Technique

The heart was accessed through a median sternotomy. Cardiopulmonary bypass (CPB) was initiated with cannulation of the distal ascending aorta and the left persistent superior, superior, and inferior caval veins. Cardioprotection was achieved with moderate hypothermia and cold intermittent antegrade blood cardioplegia. The pulmonary trunk was located posteriorly and slightly leftward toward the aorta. Following cardioplegic arrest, both great vessels were transected. After a complete examination of the aortic root, the left coronary artery was removed as a button, and the right coronary artery was left attached to the aortic root. The aortic root was mobilized, and the proximal aspect of the right coronary artery was dissected from the surrounding tissue. The main and branch pulmonary arteries were dissected extensively and looped. The LVOT was hypoplastic, with an annulus size of 4 to 5 mm. The LVOT was enlarged by incising the infundibular septum and trimming the hypertrophied muscle bands. The aortic root containing the right coronary artery was translocated with a counterclockwise rotation to the remodeled LVOT. A V-shaped Dacron patch was used to reconstruct the new outflow tract and close the VSD. The detached left coronary artery was then reimplanted to the translocated aorta. The Lecompte maneuver was performed, and the aortic anastomosis was completed. A 14-mm Contegra valved conduit (Medtronic, Minneapolis, MN, USA) was used to establish continuity between the right ventricle (RV) and the pulmonary artery. The CPB and aortic cross-clamp times were 133 and 111 minutes, respectively. The patient was successfully weaned from CPB with low-dose inotropic support. The postoperative follow-up was uneventful, and the patient was extubated on the first postoperative day. A postoperative echocardiography examination revealed mild pulmonary

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stenosis and a minimal tricuspid valve insufficiency. The patient was discharged on day 7 without any problem.

DISCUSSION

TGA with VSD and LVOTO represents approximately 25% of all transposition cases. Since it was first described in 1969 [Rastelli 1969], the Rastelli procedure has become the most common surgical technique used in the management of this pathology [Morell 2005; Bautista 2007; Yeh 2007; Hu 2008; Hazekamp 2010]. Even though this procedure proved very useful and had an acceptable early-mortality rate, several authors have found the long-term results of the Rastelli procedure to be suboptimal. LVOTO, which develops in up to 10% of patients, is caused by the natural tendency of VSDs to close over time and by the inability of the artificial material used to construct the LVOT tunnel to grow [Kreutzer 2000; Dearani 2001]. In addition, conduit obstruction and rhythm disturbances are frequently reported, and 20-year survival rates are low [Kreutzer 2000; Dearani 2001; Morell 2005]. As an alternative, Lecompte et al [1982] developed the REV procedure. With this method, the right ventricular outflow tract (RVOT) is reconstructed by directly anastomosing the pulmonary artery to the RVOT and leaving it valveless. The Metras repair is a modification of REV technique in which the pulmonary artery is connected to the RV with an aortic-tube autograft [Metras 1997]. Metras and colleagues indicated that the Rastelli procedure was a significant independent risk factor for reoperation, with the REV/Metras procedures and the Nikaidoh operation having the lowest reintervention rates [Hazekamp 2010].

In 1984, Nikaidoh introduced a new technique, a combination of the Ross, Konno, and Jatene procedures [Nikaidoh 1984]. With this technique, the aortic root is mobilized and translocated without detaching the coronary arteries. It also preserves more of the RV volume, because the RV volume is not compromised by an interventricular tunnel—a crucial consideration for patients with a small RV [Hazekamp 2010]. In the presence of some anatomic variations, such as a remote restrictive VSD, a straddling mitral or tricuspid valve, or an abnormal course of a major coronary artery crossing the RVOT, for which Rastelli repair and its modifications are contraindicated, the Nikaidoh operation may be the first choice of surgical treatment. In our patient, the VSD was subpulmonic and slightly restrictive. Therefore, we elected to perform a Nikaidoh operation instead of a Rastelli-type repair, which might have required a large septal resection.

Nikaidoh operations require coronary reimplantation, and that is considered a major risk factor for increased mortality and morbidity. The patient's coronary anatomy should be examined meticulously before and during surgery. Three of the 13 patients in the experience of Nikaidoh et al had right coronary insufficiency and required coronary transfer [Yeh 2007]. Because of the concerns about coronary insufficiency, Morrell et al chose to proceed with an individual coronary artery transfer during translocation [Hazekamp 2010]. In our case, we used this modification of the Nikaidoh operation and successfully avoided coronary insufficiency. We strongly recommend coronary reimplantation

when there are any signs of kinking or tension.

In conclusion, aortic translocation must be considered an option in the surgical management of patients with TGA, VSD, and LVOTO, especially when the presence of any of the anatomic variables mentioned above might compromise the performance of a Rastelli repair or its modifications. Aortic translocation provides direct alignment between ventricles and their corresponding arteries and thus may produce a better long-term outcome in terms of the patient's hemodynamics. The low reoperation rate for the right and left ventricular outflow tracts at the midterm follow-up seems promising, yet the operation's long-term benefits need to be evaluated with larger numbers of patients and longer-term follow-up data.

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