Case report - Congenital

Half-turned truncal switch operation for transposition of great arteries with ventricular septal defect and pulmonary regurgitation

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Abstract

A three-month-old girl weighing 4.2 kg, diagnosed with transposition of the great arteries (TGA) and ventricular septal defect (VSD) was referred to us. She had normal-sized pulmonary annulus and moderate pulmonary regurgitation. Because her pulmonary valve was not suitable for systemic circulation due to valvular incompetence, the half-turned truncal switch operation was selected. The postoperative course was uneventful without left or right ventricular outflow obstructions over a year of follow-up. Our report demonstrated that the TGA and VSD with normal pulmonary annulus is not contraindicated for half-turned truncal switch operation.

Keywords: Coronary heart disease; Arterial switch operation; Infant; Pulmonary valve

1. Introduction

For transposition of the great arteries (TGA) and a ventricular septal defect with pulmonary regurgitation (PR) and normal pulmonary annulus, the Rastelli et al. \cite{1} or réparation à l’étage ventriculaire (REV) \cite{2} procedures are selected by many surgeons. Recently, the half-turned truncal switch operation (HTTS) has been reported by Yamagishi and colleagues \cite{3} for TGA with VSD and valvular pulmonary stenosis (PS). This HTTS was designed to ensure straight and non-obstructive aortic and pulmonary ventricular outflow tracts by using an autologous half-turned truncal block that involves both semilunar valves. We applied this procedure to TGA and VSD with the normal-sized pulmonary annulus and pulmonary regurgitation.

2. Clinical summary

A three-month-old girl weighing 4.2 kg, diagnosed with TGA and VSD was referred to us. Her echocardiography demonstrated TGA with anterior aorta, a large doubly committed subarterial VSD, and both mild PS with pressure gradient of 20 mmHg, and mild PR with normal pulmonary annulus (12 mm in diameter). Her pulmonary valve was not suitable for systemic circulation due to valvular incompetence despite normal annular size. The Rastelli or REV procedure may have been suitable, however, a warped left ventricular outflow tract due to large pulmonary annulus could have caused obstruction. Therefore, we selected the half-turned truncal switch operation (HTTS).

The ascending aorta was anterior to the main pulmonary artery (MPA). The pattern of coronary arteries was Yacoub type A. An arterial cannula was inserted into the distal ascending aorta, and venous cannulas were directly placed to the superior and inferior venae cavae. Under the moderate hypothermic cardiopulmonary bypass and subsequent cardiac arrest, the ascending aorta was transected 5 mm above the coronary orifices. The MPA was transected obliquely from the posterior aspect of the proximal site to the anterior aspect of the bifurcation. The pulmonary valve was tricuspid, and annular size was 12 mm in diameter, however, the valve leaflets looked thick and edematous. Both right and left coronary buttons were resected and both coronary arteries were dissected from the ventricular myocardium for about 10 mm long. The incision line of the truncal root was designed around both aortic and pulmonary valve annuli. At first, the right ventricular outflow tract was incised along the aortic annulus. The incision was extended along the pulmonary annulus. To avoid the mitral valve injury, the posterior leaflet of pulmonary valve was left. A truncal block was resected (Fig. 1a), and half-turned horizontally. The posteriorly translocated aortic valve was anastomosed to the left ventricular outflow tract with a continuous 6-0 polypropylene suture (Prolene, Ethicon, Inc, Somerville, NJ, USA). A polytetrafluoroethylene (ePTFE) patch (W. L. Gore & Associates, Inc, Flagstaff, AZ, USA) was used to close the VSD with a continuous 6-0 polypropylene suture. A straight left ventricular outflow tract was then created (Fig. 1b and c). The coronary buttons were anastomosed to the confronted aortic wall defects with
continuous 7-0 polypropylene suture. After the pulmonary bifurcation was translocated anteriorly, the ascending aorta was reconstructed in end-to-end fashion. The posterior wall of the proximal pulmonary stump was directly anastomosed to the posterior wall of the pulmonary bifurcation. The anterior wall of the neo-right ventricular outflow tract was covered with ePTFE patch with a monocuspid fan-shaped ePTFE valve \[4\], to adjust the position of the native pulmonary valve leaflets (Fig. 1d). Transesophageal Doppler echocardiography showed laminar flow through a straight left ventricular outflow tract and a non-obstructed right ventricular outflow tract without pulmonary regurgitation. The delayed sternal closure was performed on the third postoperative day, and the postoperative course was uneventful. The patient is now doing well, and her echocardiography showed no left and right ventricular outflow obstructions during 18 months of follow-up periods.

3. Discussion

The HTTS was reported for TGA and VSD with PS as an alternative of Rastelli or REV procedure because the development of outflow obstruction of the left or right ventricle was inevitable as late complications \[5, 6\]. As another option, the Nikaidoh operation \[7\] is well known to solve disadvantages of the Rastelli or REV procedures, however, it has serious complications, such as coronary insufficiency and subsequent myocardial damage. Recently, several publications have described the application of the modified Nikaidoh operation without complications, such as myocardial damage \[8\].

The contraindication of HTTS has complex coronary patterns, such as the right coronary artery crossing the right ventricular outflow tract \[3\]. However, Dr. Yamagishi did not recommend this procedure for TGA with normal-sized pulmonary annulus, because of the possibility of coronary insufficiency due to stretching of arteries. Therefore, we dissected enough coronary arteries for re-implantation to truncal block as well as arterial switch operation. The size of the aortic annulus was almost the same as the pulmonary annulus in our patient. In fact, the postoperative three-dimensional (3D) computer tomography (CT) showed almost the same image as after the arterial switch operation with Lecompte maneuver (Fig. 2). However, we recommend HTTS should be performed for the patient with Yacoub type A coronary artery pattern. The preserved autologous pulmonary valve combined with a monocuspid fan-shaped ePTFE valve is effective to prevent

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Fig. 1. (a) Truncal block, which included the entire aortic and two leaflets of pulmonary valves, was resected. Doubly committed subarterial VSD, left and right ventricular cavities can be seen. (b) The resected truncal block was half-turned horizontally. The posteriorly translocated aortic annulus was anastomosed to the left ventricular outflow tract. The VSD was closed with an ePTFE patch. A straight and wide-open left ventricular outflow tract is demonstrated. (c) The truncal block was anastomosed to both left and right ventricular outflow tract. (d) The anterior wall of the neo-right ventricular outflow tract was covered with ePTFE patch with a monocuspid fan-shaped ePTFE valve, to adjust the position of the native pulmonary valve leaflets. ePTFE, Polytetrafluoroethylene; VSD, ventricular septal defect.
pulmonary regurgitation. The HTTS procedure is so complicated that it requires dedicated skills and enough cardiac arrest time to complete procedure, compared to Rastelli or REV procedures. Nevertheless, in some patients with TGA, VSD, and incompetent pulmonary valve, HTTS could be the best approach to avoid late complications.

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References


Fig. 2. The postoperative three-dimensional computer tomography demonstrated almost the same image as after arterial switch operation with Lecompte maneuver. ePTFE, Polytetrafluoroethylene.