Double-Outlet Technique for Tetralogy of Fallot-Type Diseases with an Anomalous Coronary Artery: Case Report

Anormal Koroner Arterle Birlikte Olan Fallot Tetraloji Tipi Hastalıklarda Double Outlet Tekniği

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ABSTRACT In Fallot-type diseases, the main goal of the operation is to reduce the right ventricular systolic pressure to less than two-thirds of the systemic systolic pressure. For this purpose, usually transannular patch with otolog pericardium have been used. An anomalous coronary artery transversing the right ventricular outflow tract (RVOT) is a major surgical challenge in tetralogy of Fallot-type disease (TOF) with a small pulmonary annulus. In these cases, conduits are frequently used and reoperations are required over time. With the use of this technique, it is possible to preserve the anomalous coronary artery in definitive operation for TOF-type disease. Also the posterior wall of the constructed pathway consists of autogenous tissue with preserved growth potential. In this study, we presented reconstruction of the right ventricular outflow pathway in a case of tetralogy of fallot-type double outlet right ventricle with abnormal coronary artery.

Key Words: Tetralogy of fallot; coronary vessel anomalies; pulmonary valve stenosis

ÖZET Fallot tetralojisi tipi hastalıklarda temel amaç, operasyon esnasında sağ ventrikül basıncını, sistemik basıncın üçte ikisinin altına indirmektir. Bunun için en sık otolog perikart ile transanüler yama kullanılmaktadır. Küçük pulmoner anulusu olan Fallot Tetralojisi tipi hastalıklarda, sağ ventrikül çıkış yolunu çaprazlayan anormal koroner arterler en önemli cerrahi problemi oluşturmaktadır. Bu tür hastalarda konduitler sıklıkla kullanılır ve uzun dönemde reoperasyonlara gerek duyulur. Fallot tetralojisi tipi hastalıklarda kullanılan bu teknik, anormal çıkışlı koroner arterleri korumaktadır. Bununla birlikte arka duvarı otolog doku ile oluşturulan yolun büyüme potansiyeli korunmuş olur. Bu yazıda koroner arter anomalisi ile birlikte sağ ventrikül çıkış yolu rekonstrükte edilen fallot tipi çift çıkımlı sağ ventrikül olgusunu sunmaktayız.

Anahtar Kelimeler: Fallot tetralojisi; koroner damar anomalileri; pulmoner kapak darlığı

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The aim of the operation is to reduce the right ventricular (RV) pressure and the pressure gradient between the RV and the pulmonary artery (PA) in Tetralogy of Fallot-type disease. Generally, transannular patching was required when the pulmonary annulus is extended to be too small to lead to acceptable postoperative RVp/LVp less than 0.65. If the anomalous coronary artery exists in the RV outflow tract, the procedure can not be done. This double outlet technique would be associated with durable relief of right ventricular outflow tract obstruction and makes potential for growth of the surgically created outflow pathway.

CASE REPORT

A 1-year-old boy, cyanotic since birth due to a double-outlet right ventricle with ventricular septal defect and valvular pulmonary stenosis. The S1 and S2 are normal, systolic ejection murmur of 3/6 degree is heard on the left sternal border, at 3-4th intercostal space. Auscultation of the lungs is normal. Other physical findings are normal including the femoral pulses.

A two-dimensional echocardiography was performed and revealed ductus arteriozus and right arcus aorta, aorta was left sided to the pulmonary artery. In the angiograms, right ventricle is larger than normal. Pulmonary valve is hypoplastic. Intraoperative findings showed that the right coronary artery originated from the left coronary artery, transversing the right ventricular out flow tract (RVOT) very near the main pulmonary trunk. Cardiopulmonary bypass with moderate hypothermia was used. After cardioplegic arrest, a vertical infundibulotomy incision was made beginning a few millimeters below the level of the coronary artery that crosses the right ventricular outflow tract. Hypertrophied abnormal muscle bundles were divided and resected through this incision. The ventricular septal defect was closed with a synthetic patch through this right atriotomy incision. Two parallel longitudinal incisions in the main pulmonary artery were connected by a transverse incision so that a wide flap was created that is of sufficient length to reach the edge of the ventriculotomy (Figure1A). After pulmonary valvotomy, the flap is turned down onto the anterior surface of the infundibulum such that it lies over the course of the anomalous coronary artery (Figure 1B). The pulmonary artery flap was approximated to the superior edge of the ventriculotomy. Subsequently, a hood of oval-shaped glutaraldehyde-treated pericardial patch was circumferentially sutured to the edge of the ventriculotomy, both edges of the pulmonary artery flap, and the edge of the pulmonary arteriotomy (Figure1C). At the end of this procedure, the right ventricle has two outflow tracts: a presumably restrictive pathway through the infundibulum and native pulmonary valve; and the new pathway was created using the flap of the pulmonary artery wall and the roof of pericardial tissue (Figure 2). The peak-to-peak gradient between the right ventricle inflow and the branch pulmonary

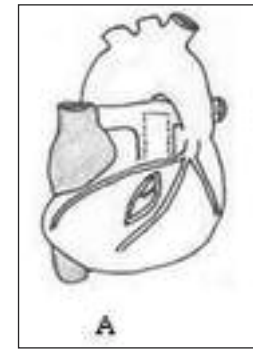

FIGURE 1A: Two paralel longutudinal incisions in main pulmonary arter yare connected distally, thus creating wide flap of pulmonary artery tissue.

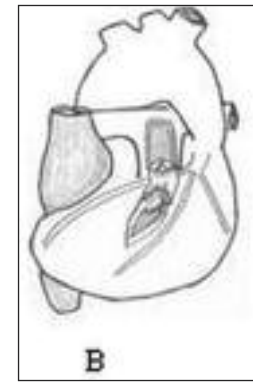

FIGURE 1B: Pulmonary artery flap is sutured to superior edge of ventriculotomy.

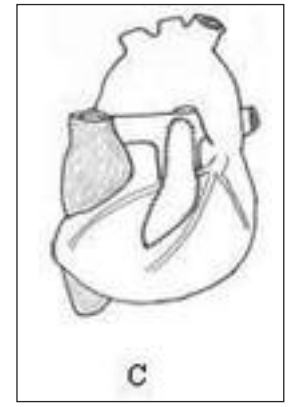

FIGURE 1C: Glutaraldehyde-treated pericardial patch is circumferentially sutured to the edge of the ventriculotomy, both edges of the pulmonary artery flap, and the edge of the pulmonary arteriotomy.

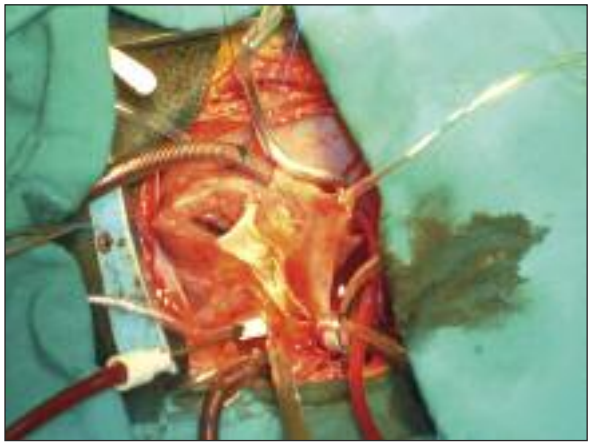

FIGURE 2: Posterior part of the new pathway created using the flap of the pulmonary artery wall.

arteries was 15 mmHg after cardiopulmonary bypass. Hemodynamically there was no evidence of residual RVOT obstruction (intraoperative RVp/LVp 0.55). The patient discharged 7 days after the operation and 9 months after the operation his functional capacity was New York Heart Association (NYHA) ClassI and echocardiography indicated a 17 mmHg pressure gradient across the RVOT, and mild pulmonary insufficiency.

DISCUSSION

Abnormal coronary artery anatomy, with a major coronary vessel crossing the outflow tract of the right ventricle, poses special problems during repair of tetralogy of Fallot-type disease. The incidence of coronary artery anomalies in tetralogy of fallot is reported to be 2% to 10%.[1] The most common of such anatomical variants is right coronary origin of the anterior descending artery, such that the anterior descending coronary artery crosses the outflow tract of the right ventricle.[2] Less commonly, there is a single coronary artery, or right coronary origin of the circumflex artery, or dual blood supply to the anterior septum with the portion nearer the base of the heart supplied by a vessel originating from the right coronary artery, and that portion nearer the apex supplied by a branch of the left coronary artery.

Various procedures for the repair of Fallot-type disease with the anomalous distribution of coronary arteries over the RVOT and small pulmonary valve annulus have been reported.

In such cases, oblique ventriculotomy, two patch repair, transannular patch repair under a mobilized coronary artery, transatrial resection of subpulmonary obstruction and extracardiac conduits have been used. The use of conduits in infants and young children carries a risk of recurrent RVOT obstruction, with the need for reoperation as the child outgrows the prosthesis.

Excellent results achieved by using pericardial patching to right ventricular outflow tract and the use of nonvalved pericardial conduits for Tetralogy of Fallot-type disease (TOF) and pulmonary atresia.[3,4] Another benefit is that none of the patients who underwent reoperation had to have the conduit replaced, just enlarged.[5] Schlichter and colleagues have reported their study which compares autologous pericardial valved conduits with the other conduits. Their long-term results are excellent and can be compared favorably with other conduits.[3] Their study shows a freedom from reoperation of 80% at 10 years compares favorably with data on all other available conduits.[3] Isamatsu and colleagues have reported their study which compares long term results of the use of equine pericardial conduits, autologous pericardial conduits and direct anastomosis repair.[5] They suggest to use direct anostomosis when possible. It is between the PA and RV by bringinng down the distal end of the PA to the ventriculotomy and covering the anterior aspect of the outflow tract with an autologous pericardial monocuspid patch.

Double outlet technique described in1995 by van Son, appears to provide adequate decompression of the right ventricle.[6] Dandou et al and Asano et al have used similar techniques.[2,7] Theoretically, it has the advantage of potential growth of the surgically created outflow pathway that has been constructed in part from a flap of viable autologous vascular tissue and without a negative effect on the coronary artery. These method has several advantages, including low cost, easy construction, absence of antigenicity, capability of increasing its diameter and no need for sterilization.

This technique shares with simple transannular patching the virtual certainty of some degree of pulmonary insufficiency. Dandou et al report pulmonary restenosis in a case either.[2]

Use of this technique has made it possible to extend the policy of primary repair of tetralogy of Fallot Type disease in symptomatic patients to those with a variety of abnormalities of coronary artery anatomy. It is important to decompression the right ventricle in these patients but also it is important to use materials there are available to growth potentials by the way reducing the stenosis rates and time intervals to re-operation.

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