Early double valve re-replacement after Ross operation

Ross ameliyatı sonrası erken dönemde çift kapak re-replasmanı

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Introduction

Although Ross procedure, a method for pulmonary autograft replacement of the aortic valve, had been first described in 1967, it had not been frequently applied till 1997 when long-term success reports were published (1). Hence, it has been widely used in children with aortic diseases in recent years (2, 3). The degeneration of the graft placed on the right ventricular outflow tract and the aortic root dilatation are the major problems occurring after the operation (2, 4). Here, we report a case in which both of these complications occurred in a short time of 5 years after the application of Ross procedure.

Case Report

Ross procedure with aortic bioprosthesis in pulmonary position (Medtronic, Freestyle aortic root bioprosthesis, no:23) had been applied in a 14-year-old male patient suffering from severe aortic insufficiency secondary to acute rheumatic fever.

Five years after the operation, auscultatory findings confirmed by the echocardiographic examination, showed moderate to severe aortic insufficiency, ascending aortic aneurysm, pulmonary valvular regurgitation and a pressure gradient of 60 mmHg between right ventricle and pulmonary artery. Magnetic resonance imaging (MRI) angiography revealed 5.5 cm aneurysmatic dilatation of the ascending aorta including the aortic root. Since each of these lesions was indicative of surgery according to the American Heart Association (AHA) guidelines, reoperation was decided for both aortic and pulmonary outflow tracts.

The functional status according to New York Heart Association (NYHA) classification was class II. There were no additional findings on the examination and laboratory findings were in normal ranges.

Surgical Technique

Following median sternotomy and meticulous dissection of the adhesions, extracorporeal circulation was initiated using aortic and bicaval cannulations. The patient was cooled 26°C and following cardioplegic diastolic arrest the pulmonary autograft in the aortic position was incised. The pulmonary autograft wall appeared to be thin and the valves of the graft were retracted. After preparing the coronary ostial buttons pulmonary autograft was completely resected from the aortic root. The proximal part of the composite Dacron graft (Medtronic no:27) was implanted in the aortic root with pledgetted mattress sutures. Following the anastomosis of coronary buttons to the openings on the graft, distal end of the composite graft was anastomosed to the ascending aorta just 1 cm proximal to the brachiocephalic artery.

The bioprosthesis on the right ventricular outflow tract (RVOT) was deformed due to the pressure of the aneurysmatic aortic root, and was highly degenerated. The prosthesis was almost entirely removed despite difficulties encountered particularly at the annulus area. The incision was extended on the RVOT about 3 cm and the distal pulmonary artery was prepared just before the bifurcation. The bovine jugular vein conduit (Medtronic, Contegra No:22) was interposed between the right ventricle and the pulmonary bifurcation. Aortic clamp time was 159 minutes and the extracorporeal circulation time was 244 minutes.

Microscopic Findings

The microscopic examination of the aortic pieces showed endothelial damage, fresh thrombus, fibrosis, and vascularization on the aortic wall. The adventitia showed inflammation and fibrosis (Fig. 1). Pulmonary autograft also had fibrosis and extensive endothelial damage (Fig. 1). There were perivascular cellular infiltration and necrosis owing to reaction to the suture material. Fibrosis and inflammation were also observed on the microscopic evaluation of the bioprosthesis.

Postoperative Course and Outcome

The patient was transferred to the intensive care unit with moderate dose of dopamine and was extubated on the 10th hour. Heparin was started in the early period and further was replaced by aspirin and warfarin combination therapy. He was discharged on 7th postoperative day from hospital. Echocardiographic examination on the second month showed well functioning prosthesis in the aortic position and there was no gradient in the RVOT. The MRI angiography revealed no anomaly for both of the conduits (Fig. 2).

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Discussion

For some patients, the application of Ross procedure is unfeasible and causes complications. Some connective tissue diseases, such as Marfan's syndrome, may affect and disqualify the pulmonary valve from consideration of replacing as an autograft (4-6). Additionally, the use of a pulmonary autograft in young patients with rheumatic disease is still debatable. Choudhary et al. (5) pointed out that the rheumatic process is the main cause of the early failure of pulmonary autograft in patients less than 30 years of age. They observed the signs of valvulitis via microscopic evaluation. Young age may play a role in early failure of the autograft. They also could not find any differences between techniques applied for these patients (5). Other group of surgeons recommended that the pulmonary autograft may become involved particularly in young patients with concomitant mitral valve disease (7). Poor results have been described in patients with rheumatic etiology of the aortic root as the underlying process, both of which may affect the live tissue autograft and cause postoperative progressive neoaortic insufficiency. However, in our case the microscopic evaluation did not confirm this process. But, this progression can play a role in early dilatation.

Main problems in the surgical management of aortic valvular disease are small size of the annulus, growth potential of the valve along with the body, high systolic pressure gradients causing systolic overload of the left ventricle, hemolysis to some extent, and the risks of the anticoagulant drugs (3).

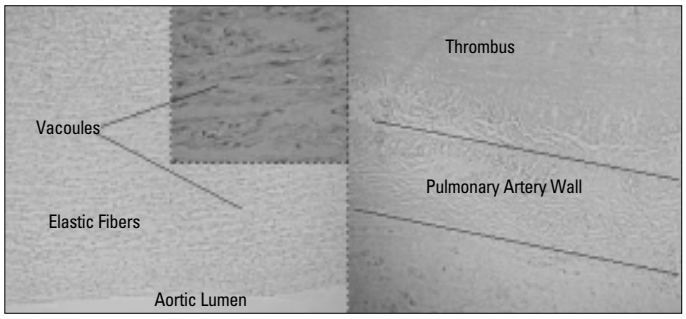

Figure 1. A degenerative aortic wall is illustrated. Diminished elastic fibers and increased number of vacuoles are demonstrated

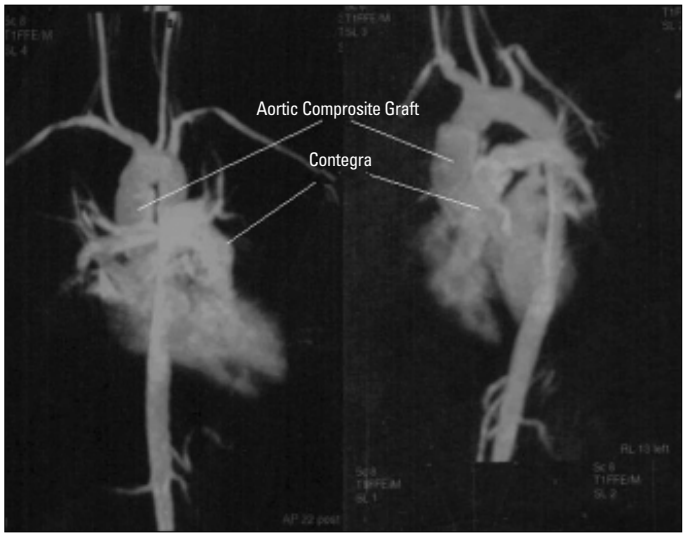

Figure 2. MRI evaluation demonstrated the RV outflow tract and aortic root after the reoperation

MRI- magnetic resonance imaging, RV- right ventricular

Root dilatation after operation is detected in about 30-40% of the patients and almost 20% of patients require surgical intervention (6). The main reason for the occurrence and progress of dilatation in the annulus of pulmonary autograft in early period is the mismatch between the aortic root and pulmonary autograft diameter. The difference between the structure of aortic root and pulmonary artery root is as well another factor. Even though both arise from the same embryologic origin, the supportive structures of semilunar valves and annulus are different. Nearly half of the circumference of aortic root is attached to the fibrous tissue and the rest to the interventricular septum. In contrast, the pulmonary valve is attached only to right ventricular muscle or the conal septum. Pulmonary root, exposed to systemic pressure, will be forced beyond its capacity and start to enlarge (4). It is possible that the aortic media degeneration in the histological structure of the native aorta wall may facilitate the development of aneurysm of pulmonary autograft (8). In our patient, the dilatation of the autograft, which is known to be weakly resistant against high pressure, resulted in the formation of aneurysm. The structural defect in the aortic wall increased the dilatation as well (8). The suture that has caused the necrosis on the artery wall is another situation, which will increase the degeneration of the aortic wall.

In most of the patients, in early period, secondary aortic insufficiency is detected due to the root dilatation by echocardiography. The rapid progress of insufficiency necessitates a second operation. In the reoperation, replacement of both aortic root and ascending aorta is currently the surgical intervention of choice. However, Leyh et al. (9) reported a successful valve-sparing aortic root reimplantation after Ross procedure. Although early results of this method appear to be successful, it is still a question in long-term period. Moreover, in pediatric patients, in the long term follow-up studies, composite grafts showed superior durability to the autografts and homografts for aortic position. Catteneo et al. (10) reported a series of 50 pediatric patients with aortic insufficiency and root dilatation with long-term follow-up results. Accordingly, 10-year reoperation incidence was 4% for composite grafts whereas 40% in 6.4-year for homografts. Again, in the same series, the technique of valve spearing was applied and 3 of the 14 patients were re-operated. Considering all these data, we think that it is not rational to take the risk of a third operation for aortic insufficiency developed after Ross operation by applying plasty for the adolescent patients.

The choice of the prosthesis used for RVOT reconstruction is another important issue related to the Ross operation. Today, in the majority of the series, homografts are used exclusively. Alternatively, the successful use of stentless bioprostheses for RVOT was reported as well (11). However, particularly in children, the higher probability of the degeneration of these prostheses in patients in childhood compared to the adults has become an important problem. In patients, had undergone Ross operation in childhood the frequency of reoperation due to the homograft is reported as 12% in the first 10 years (6). In our case, the degeneration of pulmonary bioprosthesis had increased probably due to the pressure and deformity caused by aortic aneurysm. Bovine jugular vein graft is a valved conduit especially preferred for RVOT

reconstruction. Both the simplicity of surgical manipulation and high degree of hemodynamic adaptation of this conduit lead to successful results (12). Recently, for the cases where the conduit used for RVOT reconstruction needs replacement, bovine jugular vein graft is preferred by several surgeons, as is the case in our clinic, even though its long-term performance is not known (13).

In literature, re-replacement is reported in several patients owing to the problems in both of the pulmonary autograft and right ventricular conduit following the Ross operation. The case presented in this report is a rarely observed one as aortic insufficiency and pulmonary stenosis is detected in the same patient concomitantly within a short time of 5 years and double valve re-replacement is applied.

In conclusion, Ross procedure is a preferable option for the children and adolescents with aortic pathologies. However, caution needs to be exercised in cases of rheumatic etiology as there is a considerable risk of involvement of the autograft as well as the homograft in these patients early after the Ross operation.

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