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The Aneurysmal Dilatation of Bovine Jugular Venous Conduit After Pulmonary Artery Reconstruction

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Aim: Bovine jugular vein graft is one of the conduits used in the reconstruction of the right ventricular outflow tract obstructions. It is frequently preferred since it is easy to provide, and the grafts available in different sizes and easy to manipulate. In some cases late term aneurysmal dilatation may occur.

Material and method: 9 year-old boy had a history of complete repair of tetralogy of Fallot, including closure of ventricular septal defect and placement of an 18-mm Contegra conduit between the right ventricle and pulmonary artery. In the fourth postoperative year, a routine follow up echocardiography showed increase of right ventricle pressure also severe pulmonary valve insufficiency and gradient across the valve was detected. An aneurysmatic dilatation was detected at the Magnetic Resonance angiography examination.

Conclusions: The aim of this report is to present our experience with this late term complication and to provide some suggestions to avoid this unfavorable outcome.

Key Words: Tetralogy of Fallot, Coronary Vessel Anomalies, Pulmonary Atresia

Pulmoner Arter Rekonstrüksiyonu Sonrası Sığır Juguler Venöz Konduitin Anevrizmal Dilatasyonu

Amaç: Sığır juguler ven grefti, sağ ventrikül çıkış yolu darlıklarının rekonstrüksiyonunda kullanılan konduitlerden biridir. Kolayca temin edilebilmesi, farklı çaplarının bulunması ve basit manipüle edilmesi gibi nedenlerle sıklıkla tercih edilir. Bazı vakaların geç dönem sonuçlarında anevrizmal dilatasyona rastlanılmıştır.

Materyal ve metod: 9 yaşında erkek hastanın hikayesinde, ventriküler septal defektinin kapatılıp, sağ ventrikül pulmoner arter devamlılığının 18-mm Contegra greftle sağlanarak Fallot tetralojisinin tam düzeltilmesi yapılmış. Post operatif dördüncü yılda yapılan rutin ekokardiyografi izlemlerinde sağ ventrikül basıncında artma ile birlikte pulmoner kapakta ileri yetersizlik ve kapak üstünde gradient gösterilmiş. MR anjiyografide anevrizmal dilatasyon görüldü.

Sonuç: Amacımız, hastadaki bu geç dönem komplikasyonu ve olumsuz sonuçlardan kaçınmak için bazı önerileri sunmaktır.

Anahtar Kelimeler: Fallot Tetralojisi, Koroner Damar Anomalileri, Pulmoner Atrezi

Introduction

In the surgical treatment of various congenital cardiac defects with right ventricular outflow tract (RVOT) anomalies, implanting a conduit in between the right ventricle and pulmonary artery is generally the preferred method. The bovine jugular vein conduits are valuable alternatives to synthetic conduits due to their natural sinus structures and valves. Therefore, it is widely accepted that these conduits with low gradients and laminary flow pattern will provide higher durability and last longer. The conduit is available in different sizes, supported or non-supported and easily provided; hence it has become the first choice of conduit material lately.

Case Report

9 year-old boy with pulmonary atresia, Fallot tetralogy and coronary artery anomaly had been operated when he was 21 months old. Modified right Blalock Taussig shunt had been performed. When he was 5 years old, total surgical correction procedure was performed. Since he had coronary artery anomaly (left anterior descending coronary artery crossing over the outflow tract), right ventricle outflow reconstruction was performed with 18 mm bovine jugular vein conduit (BJVC) (Contegra, Medtronic Inc, Minneapolis, MN).

Throughout his postoperative follow-up, he was free of his symptoms. In the postoperative fourth year follow up echocardiography, right ventricle pressure was

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measured as 68 mmHg; also severe in BJVC pulmonary valve insufficiency and gradient across the valve was detected. In cardiac catheterization, 44 mmHg systolic gradient between main pulmonary artery and right pulmonary artery was measured. There was advanced stenosis and kinking in native left pulmonary artery, therefore gradient pressure could not be measured (right and left PA orifices were 9,5 and 5,4 mm, respectively). Magnetic Resonance angiography demonstrated severe aneurysmatic dilatation of the conduit. The largest diameter measured was 40,2 mm and the graft contained thrombus material inside (Figure 1). Severe tortuosity and kinking at the proximal sites of the branches originating from the pulmonary bifurcation were detected at Computerized Tomograph angiography (Figure 2). In the light of these data, angioplasty and stent implantation were avoided.

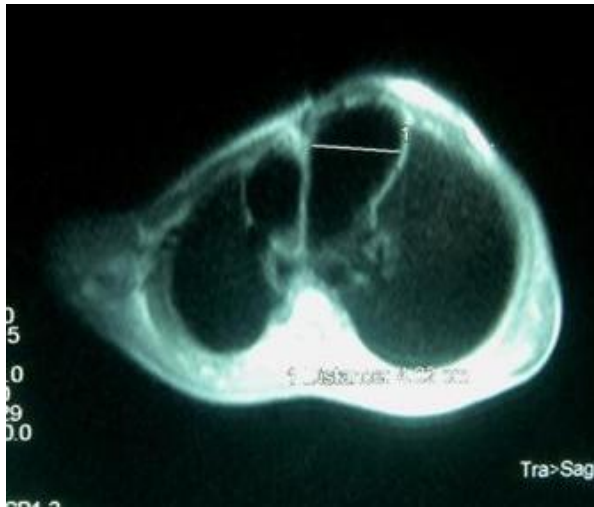


Figure 1. MRI image showing the aneurysm.

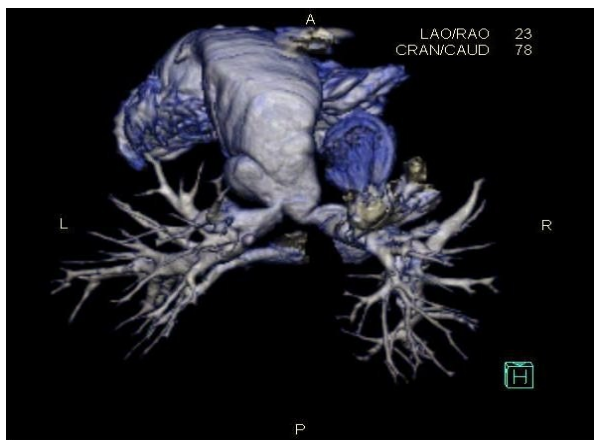


Figure 2. Cardiac computed tomography view of the Contegra graft and pulmonary artery branches.

The patient underwent operation. Cardiopulmonary bypass was achieved through right femoral artery and vein cannulation. Cross-clamp was not applied and under cardiopulmonary support, aneurysmatic conduit was totally excised. 1-1,5 cm incisions were performed to widen both pulmonary artery orifices. Patch angioplasty to the right pulmonary artery orifice by using a piece of new pulmonary conduit was performed. Following patchplasty, no 21 biological pulmonary valve conduit, Shelhigh porcine-valved conduit (Shelhigh Inc, Milburn, NJ) was implanted. Cardiopulmonary circulation was terminated without difficulty.

The patient stayed 2 days in intensive care unit and discharged home on postoperative sixth day. In the histopathological examination of the conduit, loss of elastic tissue in media layer, inflammatory cell infiltration into the adventitia layer and calcified atheromatous plaques were detected (Figure 3).

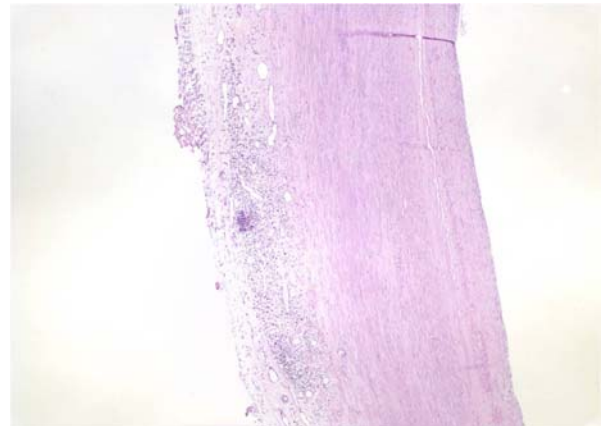


Figure 3. The histopathological view of the aneurysm wall.

Discussion

Although bovine jugular vein conduits is a new conduit, aneurysm formation in nonsupported conduits have been rarely reported.^{1,2} Many investigators have reported that the mismatch in diameter size of the small sized conduit (12-14 mm) and the pulmonary artery caused narrowing of the anastomosis which lead to the increase in the lumen pressure of the conduit and therefore give rise to the aneurysmal dilatation of the conduit.¹⁻³ As Boudjemline et al. reported, the aneurysmal dilatation of the conduit is more likely to occur in small conduits because these are implanted in neonates and young infants who have hypoplastic pulmonary arteries, making the repair particularly difficult.⁴ Brown et al. report that placing the conduit too long can cause angulation at the distal anastomosis and cause turbulent flow and may become a major cause of conduit obstruction.⁵ They suggest that

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performing the distal conduit anastomosis leftward toward the proximal left pulmonary artery is the critical point to avoid this complication.

In our patient, the late onset of stenosis in the distal anastomosis of the conduit is the main reason of the dilatation. The elevation of the pressure in the lumen of the conduit and its wall stress accelerated the aneurysmal dilatation. The dilated and probably the elongated graft caused formation of tortuous state and increased the pressure gradient in the bifurcation distal to the anastomosis and in the proximal pulmonary arteries. The valve incompetence in the conduit related to the graft dilatation might have increased the right ventricle volume load and eventually dilated the ventricle cavity.

In the histopathological examination, elastic tissue loss in the media layer was determined. The elevated pressure has widened the conduit wall and caused elongation and rupture of the elastic fibers. On the other hand, the increased pressure and the wall stress caused endothelial damage and lead to the formation of calcification of the atheromatous plaques and premature aging of the conduit.

When conduit reconstruction is performed in RVOT pathologies, the distal anastomosis and pulmonary branches should be monitored closely. When pulmonary stenosis and thereby pressure gradient is detected, preferably endovascular management in the early phase should be considered. Thus, conduit aneurysm and related complications may be avoided and the graft duration may be prolonged. Once the stenotic process starts to develop at the distal anastomosis site the dilatation and aneurysm formation in the graft is initiated.

Later on, elongation of the graft accompanies this aneurysmal dilatation and protrudes into the the anastomosis site, leading to the progression of the stenosis, thereby creating a vicious circle. In cases which are not suitable for endovascular procedures, reoperation and graft replacement may be achieved with low morbidity.

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