

## BALLOON DILATION OF STENOTIC NONVALVED CONDUITS AFTER FONTAN OPERATION\*

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**SUMMARY:** Alehan D, Çeliker A, Ceviz N. (Cardiology Unit, Department of Pediatrics, Hacettepe University Faculty of Medicine, Ankara, Turkey). Balloon dilation of stenotic nonvalved conduits after Fontan operation. Turk J Pediatr 1998; 40: 145-149.

The Fontan operation is used to supply a ventriculo-arterial connection in patients with tricuspid atresia. An important complication is the obstruction of the conduit that may necessitate reoperation. In these patients balloon dilation of the conduit stenosis has been advocated as a method to relieve the obstruction and postpone surgical replacement. While there are several reports about the balloon dilation of stenotic valved conduits, we do not have enough information about the results of balloon dilation of nonvalved conduits. We performed successful balloon dilations in two patients with tricuspid atresia who underwent the Fontan operation and had stenotic nonvalved conduits. In the first patient, the stenosis was relieved but recurred. A second balloon dilation procedure was performed, and the patient has been symptom free for one year. In the second patient, the stenosis was relieved but recurred. Our preliminary results suggest that balloon dilation is an efficient method to relieve the obstruction in stenotic nonvalved conduits and can be repeated successfully if the stenosis recurs. *Key words: balloon angioplasty, stenotic nonvalved conduits.*

At present, a definitive operation for tricuspid atresia is offered by either the Fontan or Kreutzer procedures. In the Fontan operation, a ventriculo-arterial connection is supplied by either a valved conduit between the right atrium (RA) and pulmonary trunk, connection of the RA to right ventricle (RV) with a conduit, or by direct anastomosis of the right atrial appendage to the RV. Complications of these procedures in the intermediate and long-term include interatrial and interventricular shunts and conduit obstruction due to "peel" or thrombosis. These complications may necessitate reoperation<sup>1</sup> which is more traumatic, increases hospital stay, and possibly has a higher mortality. Balloon dilation of the conduit stenosis has been advocated as a method to relieve the obstruction and postpone surgical replacement<sup>2</sup>. To contribute to the data about the benefit of balloon dilation of stenotic conduits, we report our short-term experience with balloon dilation of nonvalved stenotic conduits between the RA and the pulmonary artery (PA) in one patient and between the RA and RV in another patient, both of whom underwent the Fontan operation due to tricuspid atresia.

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## Case Reports

### Case 1

A two-month-old boy was referred to the Pediatric Cardiology Unit of Hacettepe University for evaluation of cyanosis, and was diagnosed as having tricuspid atresia, atrial septal defect (ASD) and ventricular septal defect (VSD). A left Blalock-Taussig shunt operation was performed at 32 months of age. Five years later, he underwent a modified Fontan operation and a nonvalved conduit was placed between the right atrial auricula and the infundibulum of the RV. In addition, the ASD and VSD were closed.

Four years after the operation, the patient was admitted to the hospital with massive ascites, hepatomegaly and edema due to right-sided heart failure. On cardiac catheterization, mean right atrial pressure was measured as 17 mm Hg, and mean pulmonary artery pressure as 10 mm Hg. Pressure gradient between the proximal and distal parts of the conduit was 7 mmHg. Cineangiocardiology revealed stenosis of the distal part of the conduit.

To carry out a percutaneous balloon angioplasty, a 7F endhole catheter was passed to the main pulmonary artery through the stenotic conduit, and then a 0.035 inch flexible wire was advanced across the conduit into the right PA. The endhole catheter was removed, leaving the wire in place. A 10 mm angioplasty balloon catheter was advanced over the wire for two inflations of 20 sec to a maximum pressure of 12 atmospheres. Two further inflations with a 12 mm balloon were carried out. During the first angioplasty procedure disappearance of the indentation was observed. Following the inflations, mean right atrial pressure was measured as 11 mm Hg, mean pulmonary artery pressure as 8 mm Hg, and the pressure gradient as 3 mm Hg. Two days later, symptoms of right heart failure disappeared and the patient was discharged. Two months after the balloon angioplasty, the patient was admitted to the hospital with recurring symptoms of right heart failure. Echocardiographic study demonstrated a pressure gradient of 16 mm Hg across the conduit. A second balloon angioplasty procedure, similar to the first one, was performed. After the second balloon angioplasty procedure, symptoms of right heart failure disappeared, and have not recurred during a follow-up period of one year. Control echocardiographic studies revealed no evidence of stenosis across the conduit.

### Case 2

A nine-month-old boy was admitted to the hospital with cyanosis-tricuspid atresia, hypoplastic right ventricle, ASD and VSD were detected on echocardiographic study. The diagnosis was confirmed by cardiac catheterization. Four years after the first admission, a left-modified Blalock-Taussig shunt operation was carried

out. When the patient was 8.5 years old, he underwent a Fontan operation and a dacron graft was implanted between the right atrial appendix and main pulmonary artery. Five months later, the patient was admitted to the hospital with signs and symptoms of right-sided heart failure. Cardiac catheterization revealed a mean right atrial pressure of 21 mm Hg, mean pulmonary artery pressure of 10 mm Hg, and a pressure gradient of 11 mm Hg. Cineangiocardiology demonstrated stenosis of the distal part of the conduit (Fig. 1). Similar to the procedure carried out in Case 1, a balloon angioplasty was performed with three inflations of 20 seconds to a maximum pressure of 12 atmospheres by using a 9 mm angioplasty balloon catheter. An indentation which had been observed at the beginning of the inflation (Fig. 2a), disappeared during the angioplasty (Fig. 2b). After the procedure, the diameter of the stenosis increased from 3.6 mm to 5.3 mm



Fig. 1: Right atrial angiogram in the postero-anterior projection showing severe stenosis at the distal part of the conduit (arrow).



2a



2b

Fig. 2a: Postero-anterior view showing indentation at the stenotic part of the conduit (x).  
2b: After full inflation, indentation disappeared due to enlargement of the stenotic area.

(Fig. 3). The mean right atrial pressure was measured as 15 mm Hg and the mean pulmonary artery pressure as 12 mm Hg. Pressure gradient between the right atrium and pulmonary artery decreased from 11 mm Hg to 3 mm Hg. On the Fourth day following the angioplasty, the patient was free of the symptoms of right heart failure, and was discharged. However, three months after the balloon dilation valvuloplasty, he was admitted to the hospital with recurring symptoms of right heart failure and is now awaiting stent implantation.



Fig. 3: The postdilatation angiogram demonstrating apparent enlargement of the stenotic area.

## Discussion

The extracardiac conduit operation has permitted surgical correction of a number of congenital heart diseases, but the development of progressive conduit calcification and stenosis remains a serious and nearly universal late complication<sup>1,3</sup>. It has been reported that the actuarial freedom from conduit replacement of the valved conduits is 81 percent at five years, 61 at seven years and 0 percent at 10 years, and that patients with nonvalved conduits are 100 percent reoperation free at four years<sup>4</sup>. Surgical conduit replacement can be performed at low risk<sup>5,6</sup>, but the number of surgical conduit replacements a patient can tolerate is not unlimited. Thus, by prolonging the viable lifespan of each conduit, we may be able to extend the patient's survival. Postponement of conduit replacement is particularly advantageous in the youngest children because the increased growth between operations should aid the surgeon in placing an optimum-sized conduit without intrathoracic compression<sup>3</sup>. Balloon dilation angioplasty seems to be a useful procedure to postpone the need for surgical conduit replacement in patients with stenotic conduits.

Partial and transient relief of conduit obstruction by balloon dilatation has been reported by several authors<sup>2,3,7</sup>. Lloyd et al.<sup>3</sup> reported successful balloon dilation valvuloplasty in three of six patients with stenotic valved conduits between the right ventricle and pulmonary artery. Long-term follow up results of these three

patients were not given in the paper. Sohn et al.<sup>2</sup> reported their experience with balloon dilation of stenotic valved conduits between the right ventricle and pulmonary artery in five patients, of valved homograft in the aortic valve position in one patient, and of non-valved conduit between the right atrium and pulmonary artery in one patient. Zeevi et al.<sup>7</sup> reported successful balloon dilation in three of nine patients who had stenotic bioprosthetic valved conduits between the pulmonary ventricle and pulmonary artery. One of these three patients underwent conduit replacement less than one year after the procedure with the exception of one patient reported by Sohn et al.<sup>7</sup>, in all these reports, balloon dilation angioplasty had been performed on valved conduits. To our knowledge, our patients are the second and third with nonvalved conduits to undergo balloon dilation. In stenotic valved conduits, balloon dilation is reported to be only partially and transiently successful, because of some limitations<sup>2,3</sup>. However, there is not enough data about the balloon dilation of nonvalved conduits. Sohn et al.<sup>2</sup> reported the only case who had a stenotic nonvalved conduit between the right atrium and pulmonary artery and underwent a balloon dilation. In this patient, a stent was implanted 19 months after the balloon dilation because of restenosis, and a repeated balloon dilation was not carried out<sup>2</sup>. In our first case however, a second successful balloon dilation procedure was performed, which resulted in an acceptable pressure gradient. The patient is still symptom free one year after the second dilation.

Although this is a very preliminary experience, our study suggests that in patients with nonvalved stenotic conduits, balloon dilation is a safe and feasible option for palliation of stenosis. If stenosis recurs, repeated balloon dilations may be performed to postpone the conduit replacement either to provide time for the patient's growth or to prolong the viable lifespan of each conduit.

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