

TRANSCATHETER EMBOLIZATION OF A RESIDUAL CONGENITAL CORONARY ARTERIOVENOUS FISTULA WITH A DETACHABLE BALLOON; SUPERIORITY OF INTERVENTIONAL CARDIOLOGY?*

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SUMMARY: Aydoğan Ü, Dindar A, Ayhan Yİ, Tanman B, Ertuğrul T, Ömeroğlu R, Cantez T. (Cardiology Unit, Department of Pediatrics, İstanbul University Faculty of Medicine, Çapa, İstanbul, Turkey). Transcatheter embolization of a residual congenital coronary arteriovenous fistula with a detachable balloon; superiority of interventional cardiology? Turk J Pediatr 1996; 38: 245-251.

A ten-year-old girl who presented with a continuous murmur was diagnosed with a right coronary to right ventricular fistula with colored Doppler echocardiography and selective arteriography. She underwent traditional treatment-ligation of the fistula by sternotomy. Afterwards, the systolic component of the murmur persisted and repeat arteriography showed a residual shunt through the fistula, with no change in the diameter of the right coronary artery. We describe the first case in which a residual fistula was treated with a detachable balloon embolization. *Key words: interventional cardiology, arteriovenous fistula, fistula, coronary fistula.*

Congenital arteriovenous fistulas are uncommon coronary arterial anomalies that usually cause no symptoms in young patients but are associated with symptoms and complications in older patients^{1,2}. Early elective ligation is therefore indicated because of the high incidence of late symptoms and complications. We report a case in whom a residual fistula between the right coronary artery and the right ventricle was completely occluded with a detachable balloon after an unsuccessful surgical ligation procedure.

Case Report

A ten-year-old girl was initially referred at eight years of age for evaluation of a cardiac murmur. The murmur was continuous and was best heard at the lower left sternal border. Otherwise she was symptom-free, active and thriving. The

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chest x-ray showed mild cardiac enlargement (cardiothoracic index of 55%) with increased pulmonary blood flow. electrocardiography revealed left atrial dilatation with biphasic P waves in right precordial derivations and left ventricular hypertrophy with 56 mm R waves in left precordial derivations. Two-dimensional and colored Doppler examination demonstrated a dilated right coronary artery with a fistulous connection to the right ventricular apex. Cardiac catheterization showed normal intracardiac pressures and a Qp/Qs ratio of 2.0:1.0 calculated by the Fick method. Selective right coronary angiography confirmed the echocardiographic diagnosis (Fig. 1). The traditional method of treatment was performed initially, and the patient underwent surgical ligation of the fistula by sternotomy.

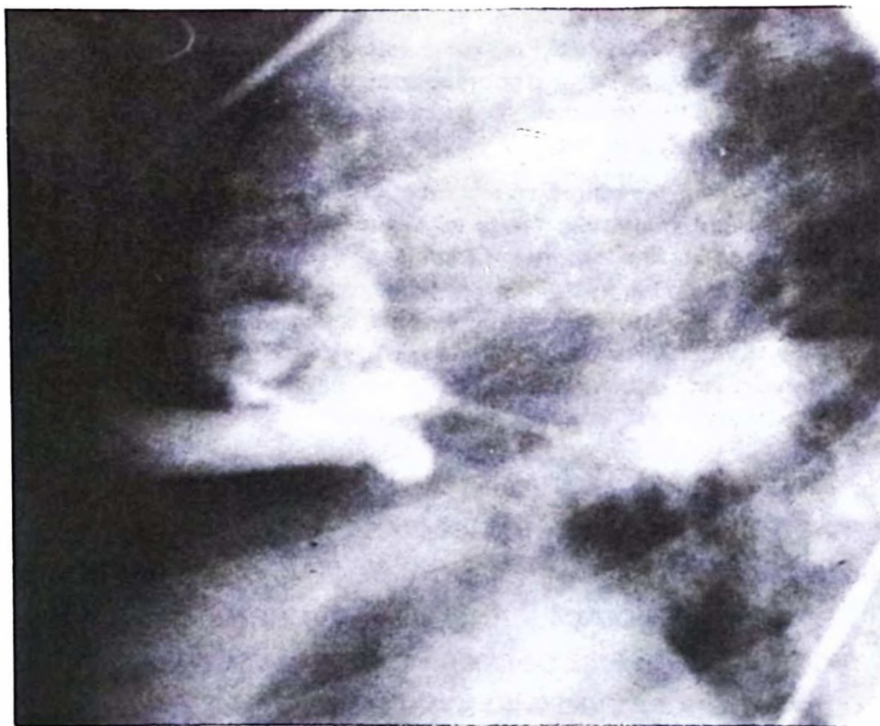


Fig. 1: Right coronary arteriography of the patient demonstrating a residual fistula between the right coronary artery and right ventricle after an unsuccessful surgical ligation procedure.

Postoperative examination of the patient revealed that the systolic component of the murmur was persisting, and repeat laboratory investigations demonstrated that there was no change in echocardiographic and radiologic findings, while electrocardiography was within normal limits. diagnostic selective coronary arteriography demonstrated that there was still an obvious shunt through the fistula. The parents resisted re-operation but preferred transcatheter intervention, and transcatheter embolization was performed two years after the initial operation.

In order to perform the procedure, a 6.5-French vascular introducing sheath was introduced through the right femoral artery with a standard Seldinger vascular puncture. A 6-French right Judkins coronary catheter was replaced with the dilator

of the sheath and the right coronary artery was catheterized. Then a 0.035" exchange guide wire was introduced through the Judkins catheter, and the catheter was removed from the sheath leaving the guide wire in position. The coaxial introducing catheter of the detachable balloon system was advanced over the guide wire up to the mid-portion of the right coronary artery, and the guide wire was then removed. Advancement of the 6.5 French (> 2 mm in diameter) coaxial introducing catheter more distally enabled it to enter the right ventricle through the fistula (Fig. 2).

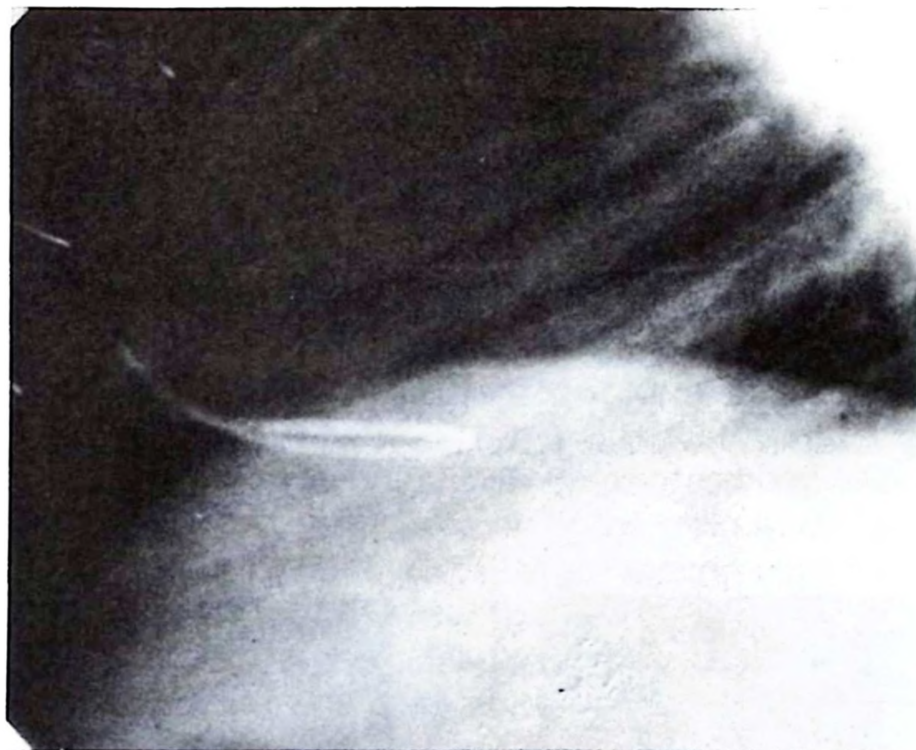


Fig. 2: Right ventriculography of the patient via a 6.5 French (> 2 mm) coaxial catheter which passed from the right coronary artery through the fistula.

The mini-balloon (Haps Emballoon; Haps ICO, William A. Cook, Australia) was mounted on the tip of its delivery catheter after it had been assembled through its coaxial teflon outer sleeve and side arm fitting (Fig. 3). Afterwards, the side arm fitting was locked onto the coaxial introducing catheter, and the delivery catheter, teflon sleeve and mini-balloon were advanced as one unit through the introducing catheter. After the exit of the mini-balloon from the introducing catheter, it was advanced more distally towards the fistula, while inflating and deflating the balloon assisted it into position. Nonionic contrast media was diluted one-to-one with distilled water in order to obtain an isotonic solution for inflation of the balloon. Coronary arteriography was performed through the side-arm fitting of the introducing catheter when it was thought that the balloon was in the target position. It showed that the shunt through the fistula was still persisting, but the

balloon was fluctuating in the right ventricle. Thus the balloon was deflated and repositioned a few millimeters more proximally and inflated again when it was thought to be in the appropriate position in the fistulous communication. It was wedged in the fistula and another arteriography was performed showing that the fistula was completely occluded, but a coronary branch artery was visualized to be originating a few millimeters proximal to the balloon, which was not obvious before the occlusion procedure (Fig. 4). The patient was monitored electrocardiographically (ECG) for 15 minutes, and the balloon was detached with gentle traction after seeing that no voltage changes had occurred. The final selective right coronary arteriogram demonstrated complete closure of the fistula.

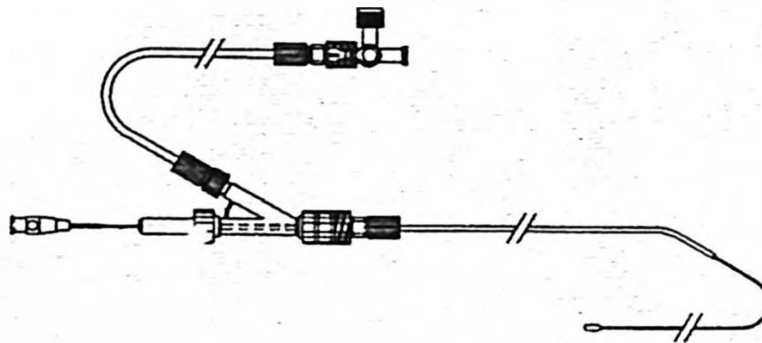


Fig. 3: Detachable vascular occlusive balloon system which was used for the coronary arteriovenous fistula occlusion procedure.

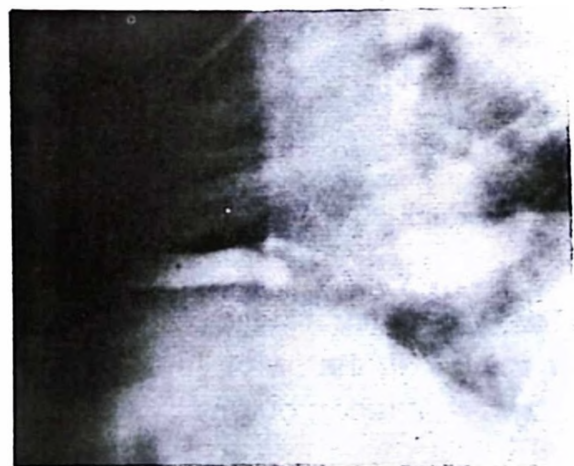


Fig. 4a: Wedging of the detachable balloon in the coronary arteriovenous fistula before detachment. b: Right coronary arteriography showing complete occlusion of the fistula and the well-visualized branch coronary artery which was partially occluded by the balloon.

The child was observed for 48 hours in the intensive care unit. Serial ECGs and a myosine band of creatinine phosphokinase levels (CPK-MB) showed normal values in this period. Colored Doppler examination performed on the third day showed no flow through the fistula, and the patient was discharged. Physical examination and colored Doppler study of the patient demonstrated normal

findings, but the dimension of the right coronary artery was still unchanged (19 mm) three months after the occlusion procedure. On the other hand, direct radioscopy of the heart on the tenth day showed that the balloon was very small compared to its original size.

Discussion

Coronary arteriovenous fistulas are uncommon, and at least initially are often asymptomatic lesions. Because of the potential for the complications^{1,3}, surgical obliteration is generally recommended, though spontaneous closure of the fistula has been reported^{4,5}. Although the operative results are good and surgical morbidity and mortality are low, the patient undergoes thoracotomy or sternotomy and, in most cases, cardiopulmonary bypass with its associated morbidity as in the case reported here. On the other hand, even in very experienced centers significant complications may occur in up to 27 percent of patients undergoing surgical closure of an isolated coronary artery fistula⁶.

It is known that coronary fistulas can often be anatomically complex^{3,6}, and attempts to close a large fistula channel surgically could result in a smaller, but hemodynamically significant, channel being missed⁷. Angiographic visualization of a secondary fistula may only be possible after the deleterious effects of a myocardial "steal" on coronary opacification are reversed by closure of the main channel. On the other hand, recanalization of the main fistula channel is also possible by the ligation procedure. Sapin et al.³ reported that the incidence of residual shunting was nine percent after ligation of a coronary artery fistula, as in the case reported here. Finally, immediate assessment of interruption of the flow in the target lumen angiographically, symptomatically and physiologically is another advantage of the transcatheter intervention to surgery.

Although various methods for performing transcatheter embolization of arteriovenous fistulas have been developed in recent years, descriptions of coronary arterial fistulas are uncommon⁷⁻¹⁶. The techniques used in embolization of such a fistula include an ivalon particle, steel coil, platinum microcoil and a detachable balloon. When ivalon particles or coils are used, it is essential for the tip of the catheter to be positioned at the point where occlusion is to be effected. This may be difficult using standard catheters, especially when the feeding arteries are tortuous or a very distal occlusion is needed. Coaxial embolization techniques with microcoils allow for a safer and more distal occlusion. When there is a high level of flow in an artery, a collection of coils packed together may be needed to occlude the fistula completely, which would be more expensive. The major advantage of using a detachable balloon is that it can be positioned in the vessel at the exact point where occlusion is required. A distal fistula can be occluded without advancing the guiding catheter into the fistula, and a

multichannel fistula can be occluded with one balloon since it assumes an elongated shape as it expands. An improperly placed balloon, unlike all other forms of embolization, can be repositioned; test occlusions can be performed before the final release. In fistulous vascular connections and malformations with large vessels and high flow, the risk of distal embolism is avoided. Another advantage of using Haps Emballoon is that it has almost no tail, unlike other detachable balloons, so the predisposition for thrombosis formation in the feeding coronary artery itself can be avoided.

There are also disadvantages to the detachable balloon technique, including the need for a large guiding catheter, the risk of early deflation of the balloon and inadvertent embolization to other sites. Detachable balloons can be inflated with either silicone or contrast medium. When a balloon is inflated with silicone, permanent occlusion results once polymerization has occurred, and this process is irreversible. Inflating the balloon with contrast medium is safer and reversible, but there is always a possibility of early deflation, as was seen by direct radioscopy of our case. Contrast medium must not be used in the coronary fistulas draining into the left side of the heart. Finally, since this is the first reported case of successful embolization of a residual coronary fistula after unsuccessful surgical intervention, this form of therapy must still be regarded as experimental until more cases are collected before saying that it is superior to surgical ligation.

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