Transcatheter Closure of Left Coronary Cameral Fistula With Amplatzer Duct Occluder II

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ABSTRACT: The surgical and transcatheter coil closure of coronary arterial fistulas are described in the literature. We report our experience with the successful transcatheter closure of a coronary arterial fistula, arising from the left coronary artery and draining into the right ventricle, with the new Amplatzer duct occluder II device.

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Key words: ADO II, arteriovenous loop, right ventricle

Coronary arterial fistulas or malformations are connections between one or more of the coronary arteries and a cardiac chamber or a great vessel, having bypassed the myocardial capillary bed. The finding of a large coronary arterial fistula is accepted as an indication for closure. Surgery has been the treatment of choice for fistula closure. Now, several studies have confirmed that transcatheter closure is feasible. Transcatheter closure of coronary arterial fistulas with coils is well described. The use of newer devices may offer advantages such as improved control of device placement, use of a single instead of multiple devices, and high rates of occlusion. We report our experience with the successful transcatheter closure of a coronary arterial fistula, arising from the left coronary artery and draining into the right ventricle, with the Amplatzer duct occluder II (ADO II) device (St Jude Medical).

Case Description

A 5-year-old, asymptomatic girl was referred for evaluation of a continuous murmur, which was diagnosed at a school health check-up. On physical examination, a grade 3/6 continuous murmur was heard at the left lower sternal border. Electrocardiogram and chest radiograph were normal. Echocardiogram showed dilated left coronary artery with a fistulous track draining into the right ventricle.

Procedure

The procedure was done under caudal anesthesia and intravenous ketamine in the cardiac catheterization laboratory. After obtaining percutaneous femoral vessel access by Seldinger's technique, 100 U/kg of heparin were administered prior to the procedure. Aortic root angiography and selective right and left coronary angiograms were done to delineate the artery feeding the fistula and its drainage (Figure 1). Angiogram showed a grossly dilated left coronary artery with an aneurysm and a fistula draining into the right ventricle. The left coronary artery and branches were poorly opacified, suggestive of coronary steal phenomenon. Through the 5 Fr cobra catheter, a 0.018″ exchange-length wire (Terumo Corporation) was advanced into the left coronary artery. Through the fistulous track, the guidewire was negotiated into the right ventricle and then into the right atrium and superior vena cava. The tip of the wire in the superior vena cava was snared from the venous side using a 15 mm goose-neck snare. An arteriovenous loop was made, and a 6 Fr shuttle delivery sheath (Cook Medical) was advanced over this wire from the venous end. However, the sheath could not be negotiated into the fistula from the right ventricular end (Figure 2). Hence, through the same delivery sheath, a 5 Fr right Judkin's guiding catheter was introduced into the fistula. A 5 x 6 ADO II device was loaded and then advanced into the Judkin's catheter and the distal skirt of the device was deployed in the aneurysmal part of the fistula. The guiding catheter was then withdrawn up to the right ventricular aspect of the fistula and the proximal retention skirt was released in the right ventricular end of the fistula (Figure 3). Repeat angiogram showed good position of the device with no residual shunt and better opacification of the coronary arteries (Figure 4). No complication occurred during or after the procedure. Electrocardiogram showed no changes. The patient was put on aspirin 5 mg/kg/day for 3 months. She was examined after 3 and 12 months and was asymptomatic with no murmur on clinical examination, and no residual shunt on echocardiogram.

Discussion

Coronary arterial fistulas are rare congenital anomalies that usually occur in isolation. The exact incidence is unknown, although they are the most common hemodynamically significant coronary artery anomalies. The artery feeding the fistula may be a main coronary artery or one of its branches. The fistula originates from the right coronary artery in about half the cases. Over 90% of the fistulas, irrespective of their origin, drain to the right side of the heart.[1] The clinical features depend upon the size and location of these fistulas and range from asymptomatic continuous murmur to congestive heart failure. Potential complications include

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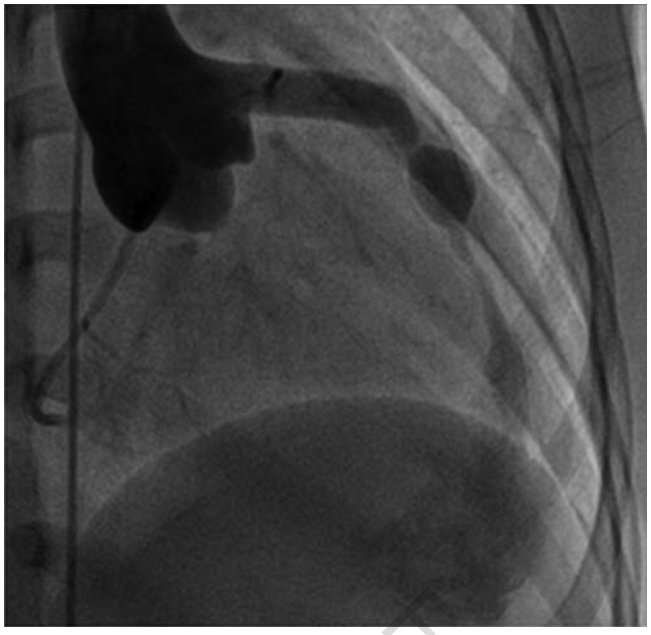

Figure 1. *Ascending aortic angiogram in right anterior oblique view shows dilated left coronary artery with an aneurysm and fistula draining into the right ventricle. Note the poor opacification of the left anterior descending coronary artery, suggestive of coronary steal.*

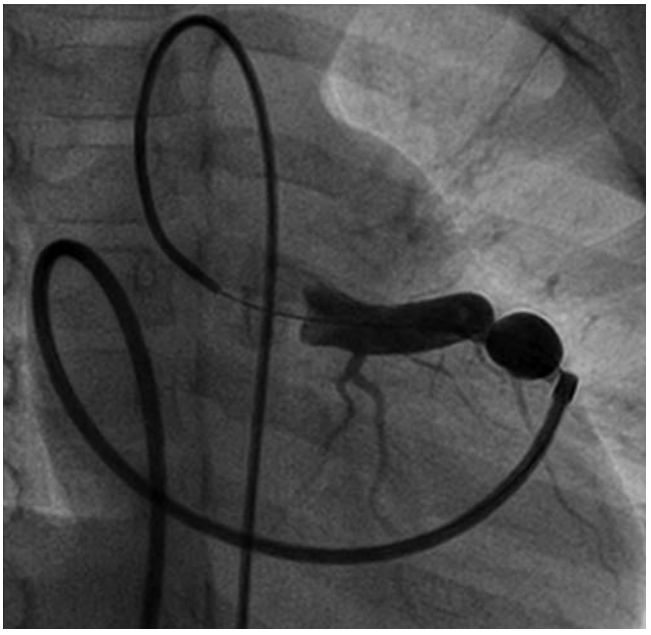

Figure 2. *5 Fr Cook's shuttle delivery sheath was advanced from the right ventricle end and hand injection shows sharp angulation and constriction in the fistulous track.*

pulmonary hypertension and congestive heart failure, with a large left-to-right shunt, bacterial endocarditis, rupture or thrombosis of the fistula, and myocardial ischemia distal to the fistula due to a "myocardial steal." Untreated larger fistulas may predispose the individual to premature coronary artery disease in the affected vessel.[2] Because of these potential complications, closure of these fistulas is advocated even in asymptomatic individuals.[3] Surgical treatment has been the standard for the treatment of coronary arterial fistulas. Complications of surgery include myocardial infarction, arrhythmia, transient ischemic changes, and stroke.[4] Transcatheter closure of coronary arterial fistulas was first described by Reidy et al in 1983 using a detachable balloon.[5] Since then, several studies have suggested that transcatheter closure of fistulas is feasible, with excellent outcomes and lesser morbidity and mortality. In this report, we describe our experience with transcatheter closure of congenital coronary arterial fistulas with a relatively newer device, the ADO II.

The ADO II is a modification of the ADO I and is made of a fabric-free, multilayered, flexible, nitinol wire mesh shaped into a cylindrical waist with two very-low profile retention discs on either end. Both discs are 6 mm larger than the diameter of the connecting waist and can swivel around the waist. Fabric-free technology allows for low-profile devices and delivery systems. Though the ADO II is designed to treat patent ductus arteriosus ≤5.5 mm in diameter with a 4 or 5 Fr catheter, it can be used safely in non-ductal positions like coronary arterial fistulas.

The formation of the arteriovenous loop during the procedure is not without risk and may entrap chordae of the atrioventricular valves, which may be damaged during manipulation of long sheaths. In this case, it was difficult to advance the delivery sheath into the fistula due to sharp angulation and constriction in the fistulous tract. Hence, a 5 Fr Judkin's right guide catheter was introduced into the 6 Fr delivery sheath to cross the constriction in the fistula.

The goal of treatment is to occlude the fistula while preserving normal coronary flow. The options are closure by surgery[6,7] or by using transcatheter devices.[4,8-14] The indications for closure are presence of a large left-to-right shunt, left ventricular volume overload, myocardial ischemia, left ventricular dysfunction, and prevention of endarteritis or endocarditis. The advantages of the transcatheter approach include less morbidity, lower cost, shorter recovery time, and avoidance of thoracotomy and cardiopulmonary bypass.[13] Percutaneous transcatheter closures, when available, should now be considered the treatment of choice.

Transcatheter closure of coronary arterial fistulas by coils and vascular plugs in children as well as adults are well described in literature.[8-11] However, coil embolization, transient electrocardiographic changes and arrhythmias, and fistula dissection are the potential complications with these devices.[4,12] Moreover, multiple coils are needed to close large fistulas, which can increase the fluoroscopy time, contrast load, and chances of failure to occlude the fistula.

Use of ADO devices to close the coronary arterial fistulas has also been published. The ADO requires a small sheath and has the ability to reposition a device until release and to recapture a misplaced device. In comparison with many devices used to close coronary arterial fistulas, the ADO has several advantages, including the use of a single device, a high rate of complete occlusion, and improved control over placement and release of the device.[13] Bruckheimer

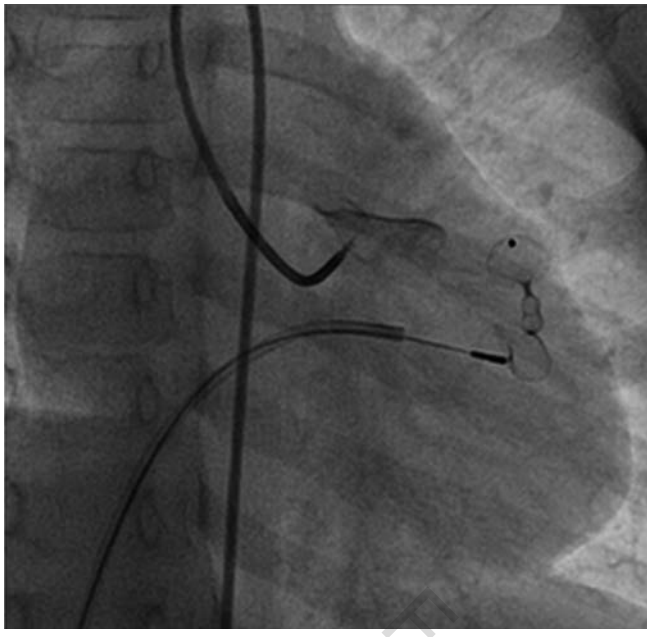

Figure 3. *The 5 x 6 Amplatzer duct occluder II device is in situ before release. The distal skirt of the device was deployed in the aneurysmal sac and proximal skirt was released in the right ventricular end of the fistula.*

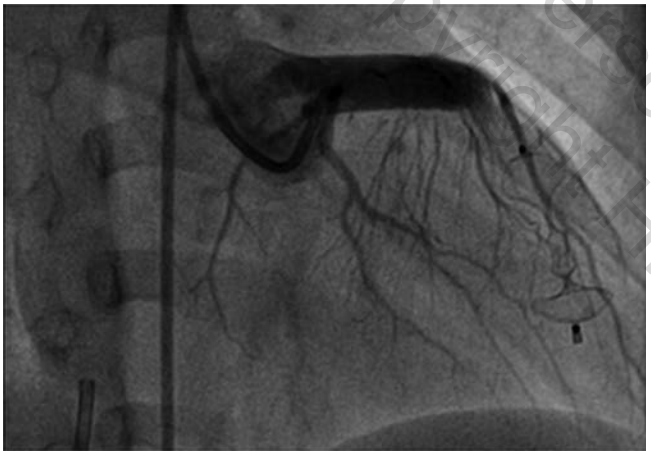

Figure 4. *Check angiogram shows no residual shunt, with good opacification of coronary arteries and the Amplatzer duct occluder II device in situ.*

et al have reported their experience with ADO devices in 10 patients of coronary arterial fistulas.[14] One procedure was unsuccessful. The ADO I device was put in 8 patients and the ADO II in 1 patient. There is a case report of a 2.5-month old symptomatic girl whose large coronary arterial fistula, originating from the right coronary artery and draining into the right ventricular outflow tract, was successfully closed with the ADO II.[15]

The ADO II has several advantages over the ADO I. The device stretches to accommodate different lengths and angles. It is a flexible and low-profile occluder (multiple layers of fine nitinol braiding without fabric), highly conformable to the anatomy (articulating "necks"), offers secure device placement, and uses low-profile delivery catheters (4 and 5 Fr) with high trackability. Only two cases of coronary arterial fistula closure with ADO II have been previously reported.[14,15] In our case, the ADO II was used because of the narrow opening with sharp angulation at the right ventricular end. To the best of our knowledge, this is the first case of left coronary arterial fistula to be closed by the ADO II device in a child. Further experience and long-term follow-up studies are required to comment on the routine use of this device for coronary arterial fistula.

Conclusion

The ADO II is a new device that is more flexible, trackable, effective, and versatile. It is low profile compared to the ADO I. The transcatheter closure of coronary arterial fistula with the ADO II is technically feasible, easy, and safe. It is a promising alternative to closure with other devices in small children. It allows more precise closure of coronary arterial fistula while preserving coronary branches.

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