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Brief Report

Transcatheter occlusion of a large coronary arterial fistula with new detachable platinum microcoils

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Abstract We report a 17 year old boy with a large fistula from the right coronary artery to the right ventricle. The fistula consisted of two major branches. The smaller branch could be embolised with three detachable platinum microcoils without problems. The high flow of blood in the larger branch, however, prevented conventional occlusion using coils. Interventional occlusion of this branch was achieved in a second attempt. Following creation of an arterio-venous wire-loop, we advanced a balloon catheter into the distal end of the fistula. Under temporary occlusion of the fistula, complete closure was achieved by delivery of 7 detachable platinum microcoils. Thus, even large coronary arterial fistulas can be closed safely with these new platinum detachable microcoils. The procedure, however, requires temporary control of the flow of blood by balloon occlusion.

Keywords: Coronary arterial fistula; transcatheter occlusion; detachable platinum microcoils; balloon blockage

CORONARY ARTERIAL FISTULAS ARE RARE, BEING found in 0.1 to 0.2% of patients who undergo coronary angiography.[1,2] Interventional or surgical occlusion of moderate sized and large fistulas is recommended to prevent increasing shunt and volume load, myocardial ischemia, formation of aneurysms, and the development of endarteriitis. Coil occlusion of large fistulas is difficult, since coils may embolize due to the torrential flow of blood in the vessel. Alternatively, other occluding devices have been used, such as the Rashkind umbrella[3,4] or the Amplatzer duct occluder.[3,5] If the fistula has a tortuous course, however, it may be difficult to introduce these large devices. We report a 17 year old patient who underwent interventional occlusion of a large fistula from the right coronary artery to the right ventricle using detachable platinum coils, which were placed during temporary occlusion of the fistula.

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Case report

The asymptomatic 17 year old patient presented to our unit for evaluation of a heart murmur which had been known since birth. He had an uneventful history. On auscultation there was a 2/VI continuous murmur over the left lower sternal border. The electrocardiogram showed no abnormalities. On echocardiography, we found normal cardiac function. The proximal right coronary artery was dilated, however, with a diameter of 8 mm. Colour doppler revealed a turbulent flow into the right ventricle, suggesting a fistulous communication.

Cardiac catheterization revealed normal pressures in the right and left heart. Angiography confirmed the diagnosis of a large fistula from the right coronary artery to the right ventricle. The proximal part of the right coronary artery was dilated giving rise to the normal branches. The tortuous fistula consisted of 2 large branches, which reunited before draining into the right ventricle. The minimal diameter of the first of these branches was 3.5 mm, while the minimal diameter of the second branch was 5.7 mm (Fig. 1). For interventional occlusion, we first placed a 5 French guiding catheter (Judkins right coronary catheter, internal diameter 0.058″) into the orifice of

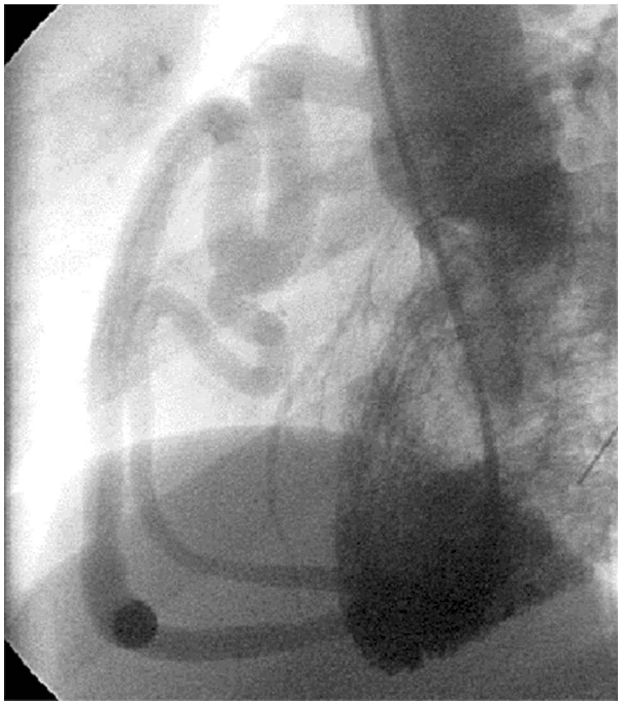

Figure 1.
Large fistula from the right coronary artery to the right ventricle, consisting of two branches which reunited before draining into the right ventricle.

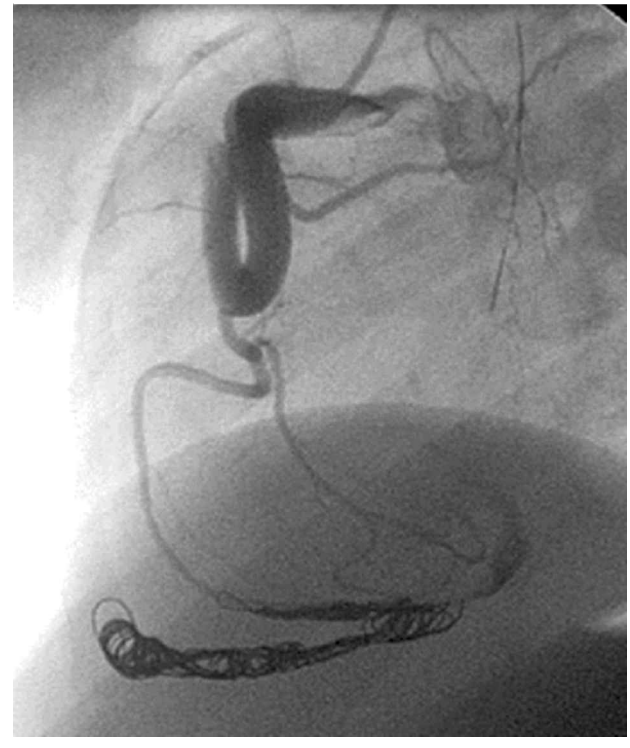

Figure 2.
Occlusion of the two branches of the fistula with detachable platinum microcoils (upper branch: 3 coils, lower branch: 7 coils). The tiny residual leak (arrow) is due to a third, hemodynamically irrelevant branch from the nondilated right coronary artery. Note that the perfusion of the native right coronary artery has improved substantially compared to Figure 1.

the right coronary artery. A 0.014″ wire (Cook®), and subsequently a 3 French catheter (Microferret 18, Cook®), were advanced into the smaller branch of the fistula. Over the Microferret catheter, 3 detachable platinum microcoils (Cook®) were deployed. These coils are attached to a delivery wire and can be released in the appropriate position by 25 counterclockwise turns of the wire. Repeat angiography demonstrated nearly complete occlusion of this branch of the fistula. Subsequently, we attempted to embolize the larger branch of the fistula. Due to the high flow of blood, and lack of a distal stenosis, we were unable to obtain a stable position during several attempts to place a coil, with the coil repeatedly migrating to the right ventricle. Since the coil was still attached to the delivery wire, it could be retrieved without complication, so the intervention was stopped at this point.

Cardiac catheterization was repeated 4 months later. Access was gained percutaneously with a 6 French sheath from the right internal jugular vein, and a 6 French sheath from the right femoral artery. A 5 French guiding catheter was placed into the orifice of the right coronary artery. A 0.032″ Termuo wire (Radiofocus®) was passed through the right coronary artery and the fistula into the right ventricle and the pulmonary trunk. The tip of the wire was snared and exteriorised over the sheath in the internal jugular vein, creating an arteriovenous wire loop. Over this wire loop, a 6 French balloon catheter (Invatec®, balloon diameter 8 mm) was advanced from the jugular vein into the right ventricular end of the fistula. The balloon was placed in the mouth of the fistula and inflated. Angiography into the right coronary artery demonstrated complete temporary occlusion of the fistula. During temporary occlusion over 20 minutes, there were no ischemic changes of the electrocardiogram. At this point we removed the wire loop, while the inflated balloon remained in place. A 3 French catheter (Microferret, Cook®) was advanced over a 0.014″ wire (Strategy, Cook®) from the right coronary artery to the remaining branch of the fistula. We consecutively deployed 7 platinum microcoils as described above. 15 minutes later, we deflated the Ivatec balloon. Angiography into the right coronary artery demonstrated complete occlusion of the fistula and the balloon was removed. The final angiogram demonstrated a tiny residual fistula originating from a small branch of the right coronary artery (Fig. 2). The postinterventional course was uneventful. Echocardiography immediately after the procedure, and at follow-up 6 months after the

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intervention, did not show any evidence of a residual fistula.

Discussion

Interventional occlusion has become the treatment of choice for the majority of patients who require occlusion of coronary arterial fistulas.[6–8] In most of the cases, interventional occlusion has been accomplished by implantation of coils. Gianturco coils, however, have the disadvantage of uncontrolled release, and require relatively large catheters for their delivery. In large fistulas with a high flow of blood, it may be difficult to obtain a stable position, especially of the first coil. Embolization of coils, therefore, has been the complication most frequently observed in these procedures. Since most of the fistulas drain to the right heart,[6] embolized coils usually migrate to the pulmonary arteries. Although most of the embolized coils can be removed by snares,[4,9,10] these complications certainly prolong the procedure and increase the time needed for fluoroscopy. In one case, a coil became entangled in the tricuspid valvar apparatus and was left in place.[3] Furthermore, due to the tortuous course of the fistulas, it may be difficult to advance the relatively large delivery catheters to the distal part of the vessel. A possible alternative is to use platinum microcoils (Target Therapeutics®).

In our patient, interventional occlusion of the larger branch of the fistula was achieved applying temporary balloon occlusion of the distal connection of the fistula to the right ventricle. Creation of a wire loop from the femoral artery to the right internal jugular vein allowed easy introduction of a balloon catheter into the fistula. Temporary occlusion of the fistula has 2 major advantages: Angiography into the coronary artery during occlusion of the fistula results in a far superior delineation of the normal coronary arterial branches and the exact anatomy of the fistula. It therefore helps to prevent inadvertent interventional occlusion of vital branches. Furthermore, temporary occlusion over 15 minutes simulates the result of the interventional procedure and allows the exclusion of possible ischemic changes on electrocardiogram.

For interventional occlusion, we used detachable platinum microcoils (Cook®) which are mounted on a delivery wire. We decided to use these coils for several reasons. First they can be delivered by microcatheters which allow selective catheterization of even very tortuous fistulas as in our patient. The stable connection of these coils with the delivery wire allows easy retrieval if a coil does not find an appropriate position. The coils are finally released by 25 counterclockwise turns of the delivery wire. With the help of a 0.014″ wire (Strategy, Cook®) it was fairly easy to advance the 3 French delivery catheter (Microferret 18, Cook Strategy, Cook®) to the distal end of the fistula just proximal to the occluding balloon. During the procedure, we used coils with a loop diameter of 6, 8 and 10 mm and a length of 12, 15, 20 and 30 cm. Due to the soft nature and high flexibility these coils fit very smoothly into anatomic structures of various shape. Since the coils we used are rather long, we were able to pack a large number of loops very tightly and obtain complete occlusion of an extensive segment by successive deployment of 7 coils. Following deflation and removal of the balloon catheter, there was no change in position of any of the coils. Our initial unsuccessful attempt, however, showed that these coils were too soft to be applied in a large fistula without prior reduction of the high flow of blood.

According to our experience, these new platinum detachable microcoils are suitable for interventional occlusion even of large coronary artery fistulas, if temporary control of the flow through the fistula can be achieved. This method, therefore, represents a possible alternative to the implantation of large devices, such as the Rashkind double umbrella or the Amplatzer duct occluder. Coil occlusion is technically no more demanding than using the latter devices, since their implantation also requires formation of an arteriovenous wire loop.

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