Percutaneous Management of Coronary Artery-to-pulmonary Artery Fistula Using an Amplatzer Vascular Plug with the Trans-radial Approach

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Abstract

Congenital coronary artery fistulas (CAFs) are rare and asymptomatic, although symptomatic CAFs should be treated with percutaneous intervention or surgery. A 62-year-old woman developed bilateral coronary-to-pulmonary artery fistulas resulting in exertional chest pain. We herein report the successful use of transcatheter closure of a coronary artery-to-pulmonary artery fistula, which lead to the coronary steal phenomenon, using an Amplatzer vascular plug with the trans-radial approach. After the procedure, the patient remained asymptomatic.

Key words: coronary artery-to-pulmonary artery fistula, coronary artery steal phenomenon, Amplatzer vascular plug

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Introduction

Congenital coronary artery fistulas (CAFs) are a rare anomaly that allows for blood outflow into the cardiac chamber, coronary sinus, vena cava, pulmonary artery or pulmonary vein. The majority of CAFs originate from the right coronary artery (RCA) or left anterior descending artery (LAD), whereas bilateral CAFs are uncommon (1). Almost all CAFs are asymptomatic; however, CAFs can result in heart failure, myocardial ischemia due to the coronary steal phenomenon, endocarditis and rupture of aneurysmal vessels (2). Therefore, symptomatic CAFs should be treated with percutaneous intervention or surgery (3, 4). We herein present the case of a patient with bilateral coronary-to-pulmonary artery fistulas and a fistula that originated from the LAD of the two fistulas, which resulted in the coronary steal phenomenon. The coronary-to-pulmonary artery fistula arising from the LAD was successfully occluded using an Amplatzer vascular plug with the trans-radial approach.

Case Report

A 62-year-old woman with no coronary risk factors was referred to the cardiology department following the onset of exertional chest pain associated with shortness of breath lasting for two months. The physical examination findings were normal, and a resting electrocardiogram showed a regular sinus rhythm. However, an exercise treadmill test showed positive results, and dyspnea was noted with horizontal ST segment depression approximately 2 mm in the inferior leads during stage 2 exercise. A transthoracic echocardiogram revealed a normal left ventricular systolic function without regional wall motion abnormalities and a right ventricular systolic pressure of 21 mmHg; however, an abnormal diastolic turbulent flow was detectable in the pulmonary trunk (Fig. 1). A left coronary angiogram showed a dilated proximal LAD and large CAF with an aneurysm measuring approximately 16 mm in diameter. The antegrade coronary flow to the mid and distal LAD was delayed (TIMI grade 2) without stenosis (Fig. 2A). A RCA angiogram also showed a CAF arising from the aorta to the pul-
Asahi Intecc, Nagoya, Japan) was introduced into the fistula. A 0.014-inch coronary guide-wire (SION Blue, inside a 6-Fr catheter and was easily intubated into the coronary artery. A 5-Fr soft straight tip guiding catheter (Heartrail, Terumo, Japan) was used as an inner catheter set inside a 6-Fr catheter and was easily intubated into the coronary artery. A 0.014-inch coronary guide-wire (SION Blue, Asahi Intecc, Nagoya, Japan) was introduced into the fistula. We then obtained a selective angiogram of the LAD with the “five-in-six” method (Fig. 2B). An intravascular ultrasound (IVUS) examination using Eagle eye platinum (Volcano Corp, Rancho Cordova, USA) performed to evaluate the precise diameter of fistula showed a size of 5 mm (Fig. 4A, C). A selective fistulogram was subsequently obtained after deep insertion of the 5-Fr inner catheter into the fistula. The selective fistulogram showed a 16x14 mm sized aneurysm (Fig. 2C); therefore we placed a 6-mm vascular plug (Amplatzer vascular plug 4, St. Jude Medical, Plymouth, USA) in the middle of the fistula. Additional injections of contrast into the coronary artery confirmed the correct position of the plug, and we then released it from the delivery cable. The final coronary angiogram showed complete obliteration of the coronary fistula, with an improved flow to the mid and distal LAD (TIMI grade 3) (Fig. 2D). However, another fistula arising from the more proximal LAD and extending to the pulmonary artery fistula remained. This fistula was small and provided no evidence of causing the coronary steal syndrome. Therefore, we did not perform any additional procedures and instead planned to perform further interventions if additional angina symptoms occurred. After the procedure, an IVUS examination showed size differences between the dilated proximal LAD (approximately 7.4 mm in diameter) and mid LAD (approximately 3.8 mm in diameter) (Fig. 4B, D). A follow-up echocardiogram revealed that the abnormal diastolic turbulent flow detectable in the pulmonary trunk had disappeared. The patient’s post-procedural course was uncomplicated, and she was discharged without any symptoms of angina. One month after the procedure, we conducted a treadmill test and coronary MDCT. A follow-up exercise treadmill test performed according to the WHOS0 protocol was terminated at the level of 100 Watts due to the onset of fatigue without ischemic changes in the II, III and aVF leads. Follow-up coronary MDCT showed that the previously noted large coronary fistula and aneurysm arising from the LAD were occluded (Fig. 3B) and that the coronary fistula arising from the RCA and small septal branches of the LAD extending to the pulmonary trunk remained. However the patient remained asymptomatic one year after the procedure.

**Discussion**

We successfully performed percutaneous intervention of a coronary artery-to-pulmonary artery fistula using an Amplatzer vascular plug. The prevalence of CAFs is relatively rare, observed incidentally on 0.05-0.2% of coronary angiograms (5). The RCA is more often involved than the LCA as a site of origin, and CAFs originating from both coronary arteries are uncommon (1). Usually, this fistula is asymptomatic; however, it can result in bacterial endocarditis, fistula rupture, myocardial ischemia and heart failure. Treatment with percutaneous intervention or surgery is recommended in patients with symptoms such as chest pain and dyspnea (3, 4).

Because of the low prevalence of CAFs, the optimal management strategy remains unclear, and there are no established therapeutic guidelines. In patients with extremely tortuous fistulas, multiple fistulas or additional cardiac disease requiring surgery (e.g., ventricular septal defects, coronary artery aneurysms or atherosclerotic coronary artery disease requiring coronary artery bypass grafting) surgical treatment is preferred (6, 7). However, surgery carries risks associated with cardiopulmonary bypass and median sternotomy. Nowadays, closure with coils is the most commonly used technique, although this procedure is difficult and time-consuming in patients with large fistulas because multiple coils are needed to occlude the site of malformation. Some interventionists attempt to occlude the aneurysm with coils considering the risk that the other collateral artery might supply the aneurysm, causing its size to increase. However, we expected that the aneurysm in the current case had been occluded with a thrombus. Fortunately, follow-up coronary MDCT showed that the previously noted large aneurysm arising from the LAD was indeed occluded with a thrombus.
In this case, the Amplatzer vascular plug offered the advantage of using a single device to obtain effective closure. Previous reports in three patients recently demonstrated trans-catheter closure of coronary arterial fistulas using an Amplatzer vascular plug to be safe and effective (8). However, in these cases, the procedures were performed under sedation with additional visualization of the anatomy via transesophageal echocardiography, whereas we did not require this supports.

Although percutaneous intervention is less invasive than surgery, it can result in serious complications, such as device migration, distal embolization, coronary dissection and fistula dissection. Device migration into the pulmonary artery or distal coronary artery can cause life-threatening complications, such as pulmonary embolism or myocardial infarction. In order to prevent device migration, it is very important to select the optimal device size and the manufacturer’s recommend selection of a plug from one-third to one-half larger than the diameter of the target vessel (3, 9). In this case, we evaluated the diameter of the fistula using multiple diagnostic imaging modalities, including coronary angiography, coronary MDCT and IVUS (10).

In summary, we herein described the case of a patient with bilateral coronary-to-pulmonary artery fistulas and a fistula that originated from the LAD of the two fistulas, which resulted in the coronary steal phenomenon. Usually, the treatment options in such cases are surgery or occlusion using coils. However, as observed in this case, occlusion with an Amplatzer vascular plug is an easy method that provides an attractive alternative to surgery or occlusion with coils. Therefore, this procedure is emerging as a successful therapeutic strategy, even in cases of large and tortuous CAFs.

Figure 2. Coronary angiography. A: A left coronary angiogram showed the dilated proximal LAD and a large CAF with an aneurysm (arrowheads, approximately 16 mm in diameter). The antegrade coronary flow to the mid and distal LAD was delayed (TIMI grade 2) without stenosis. B: We obtained a selective angiogram of the LAD using the “five-in-six” method (arrowhead: tip of 6-Fr guiding catheter, arrow: distal tip of 5-Fr inner catheter). C: We obtained a selective fistulogram following deep insertion of a 5-Fr inner catheter into the fistula. The selective fistulogram showed a 16×14 mm sized aneurysm (arrowhead: tip of 6-Fr guiding catheter, arrow: distal tip of 5-Fr inner catheter). D: The final coronary angiogram showed complete obliteration of the coronary fistula with an improved flow to the mid and distal LAD (TIMI grade 3) (arrowheads: radiopaque markers of the Amplatzer vascular plug).
Figure 3. Coronary multi-detector computed tomography. A: Coronary MDCT showed a CAF arising from the LAD with an aneurysm. B: After the procedure, follow-up coronary MDCT showed that the previously noted large coronary fistula and aneurysm arising from the LAD were occluded (*: thrombus, arrowheads: radiopaque markers of the Amplatzer vascular plug).

Figure 4. Intravascular ultrasound. A: We performed IVUS examinations before and after the procedure. B: After the procedure, IVUS showed a 7.4 mm sized dilated proximal LAD. C: Before the procedure, IVUS showed a 5 mm sized feeding vessel of fistula. D: After the procedure, IVUS showed a 3.8 mm sized mid LAD.
The authors state that they have no Conflict of Interest (COI).

References


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