Case Report

Transcatheter coil embolization of coronary artery fistulas

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Summary Congenital coronary artery fistulas (CAFs), which have been known since 1865, are rare congenital cardiac abnormalities. Most of the CAFs are discovered incidentally during coronary angiography. We described our experience with successful transcatheter coil embolization of CAFs in an adult, leading to improvement of symptoms. The patient had chest pain or dyspnea on exertion. The CAFs originated from the left anterior descending coronary artery and the circumflex artery. They all drained into the pulmonary trunk. The coils were implanted through a microcatheter, which was passed through a 7F guiding catheter. The coils were used to occlude the CAFs completely. The procedures were uncomplicated. Patient's chest pain or dyspnea resolved after the procedures. Although the patient had small residual flow at the CAFs from the circumflex artery at follow-up coronary angiography, the patient was asymptomatic. Therefore, we considered the coil embolization to be successful. Transcatheter closure of CAFs with coil is a valid option, and can be regarded as an acceptable alternative to surgery nowadays. © 2010 Japanese College of Cardiology. Published by Elsevier Ireland Ltd. All rights reserved.

1. Introduction

Congenital coronary artery fistulas (CAFs) have been recognized since 1865. CAFs are rare, accounting for approximately 0.1% of congenital cardiac abnormalities [1]. Their clinical importance is usually in adulthood due to an increased risk of complications such as heart failure, myocardial ischemia, infective endocarditis, arrhythmias, and CAF rupture [2]. Bjork first reported surgical ligation of CAFs in 1947 [3] and the first successful coil embolization of CAFs was performed in 1982 [4]. Catheter-based interventional techniques have become the procedure of choice in the current era and have emerged as an acceptable alter-
native to surgery. We describe a patient who underwent successful transcatheter closure of CAFs.

2. Case report

A 62-year-old male was referred to our hospital with complaints of weakness, easy fatigability, dyspnea, and chest pain which is typical for ischemia for the previous six months. On physical examination, his blood pressure was 146/78 mm Hg and a continuous systolic–diastolic murmur of Levine 3/6 was heard at the 3–4 intercostals spaces. Twelve-lead electrocardiogram showed a sinus rhythm and signs of left ventricular hypertrophy. Both his hemogram and blood chemistry were found to be normal. Transthoracic echocardiography showed no abnormality. Because angina pectoris was suspected, coronary angiography was performed, which revealed the fistulas communicating from the left anterior descending coronary artery (LAD) to the pulmonary artery (PA) and also from the circumflex artery (CX) to the PA (Fig. 1A). There was no significant atherosclerotic disease noticed in the coronary arteries. Because exercise cardiolite stress test revealed ischemic response in antero-septal area, we diagnosed the patient as having coronary steal phenomenon (Fig. 2A). Because his symptoms were exacerbated gradually and he refused surgical treatment, we decided to perform percutaneous transcatheter intervention. After venous administration of 5000 U heparin, percutaneous transcatheter closure was performed, via the right femoral artery for access with a Contralateral Left Support (CLS) 4.0-7F guiding catheter (Boston Scientific, Maple Grove, MN, USA) into the left coronary artery to get strong buck-up. We chose the guidewire of neo’s Fielder FC (St. Jude Medical, St. Paul, MN, USA) which has good trackerbility and steerability for the tortuosity of the CAFs. The CAF from CX was catheterized selectively by transit microcatheter (Cordis, Johnson and Johnson, Miami, FL, USA). The guidewire and microcatheter were easily inserted. The embolization was performed with complex shaped 6–50 mm (diameter–length) platinum microcoils (Trufill, Cordis, Johnson and Johnson) which were delivered through a microcatheter. It is suggested that the coil diameter is slightly larger than the vessel diameter (30% larger) to prevent coil displacement and migration. They were placed sufficiently far from the drainage opening to prevent migration into the PA and just at a vessel curve before branch. It is important to keep position of the microcatheter and release the coils just at a vessel curve. To obtain complete occlusion, coils were implanted so as to merge together forming a conglomeration. The CX–PA fistula was sealed with two 6–50 mm coils. Two coils were delivered easily without resistance during insertion and detached. Sequen-

![Figure 1](image-url)
Coronary artery fistula (CAF) is a rare condition of a direct communication between a coronary artery and one of the cardiac chambers, the coronary sinus, the superior vena cava, or the pulmonary artery. It has been reported that incidental diagnostic rate in adults was about 0.1% in patients undergoing invasive cardiovascular imaging [1]. Therefore, information regarding CAFs in adults is limited. The PA is the most common site of distal communication (37%), followed by right atrium (24%), left ventricle (15%), and left atrium (9%). When the CAFs were small, there were few complications on follow up. However, some researchers argued that the diagnosis of the large CAF is a surgical indication regardless of the existence of symptoms [5]. Early closure is mandatory to prevent complications. The main indications for closure are clinical symptoms, especially of heart failure and myocardial ischemia, and in asymptomatic patients with high-flow shunting ($Q_p/Q_s > 1.5$), to prevent symptoms or complications such as heart failure (due to left to right shunting), myocardial ischemia (due to coronary steal phenomenon), or infective endocarditis, especially in the pediatric population [2]. Surgery of direct epicardial or endocardial ligations was the main therapeutic method for CAFs until now. Surgical correction is safe and effective with good results, however percutaneous coil embolization is also a safe and effective method, and is a serious alternative to surgical treatment. The majority of case series and case reports of successful coil embolization were in children, therefore there are limited data in adults. Perry et al. [6] and Dorros et al. [7] reported successful transcatheter embolization in adults using detachable balloons, Gianturco coils, and so on. A review of the literature reported the 45 patients who had transcatheter closure of CAFs, with 91% having complete closure at follow-up imaging, and 93% remaining symptom- and complication-free [8]. Mavroudis et al. reported that patients who satisfy the following criteria: absence of multi-

![Figure 2](image)

Figure 2  Exercise cardiolite stress test, (A) before coil embolization and (B) after coil embolization.

tially, in a similar fashion, the LAD—PA fistula was easily occluded using five coils (complex shaped 6—50 mm coils). When we observed that the CAFs were completely closed, we finished the procedures (Fig. 1B). The time of the procedure was 50 min and contrast volume was 110 cm$^3$.

The procedures were uncomplicated. The patient remained chest pain-free after the procedures. A follow-up exercise cardiolite stress test performed at one month after coil embolization was negative for ischemic response; there was a significant improvement of perfusion in the anteroseptal area (Fig. 2B). We did not administer antiplatelet and anticoagulant therapy after the procedures. A follow-up coronary angiography was performed at six months after coil embolization (Fig. 3). Although the patient had trivial residual flow only at the CX—PA fistula, the patient’s chest pain and ischemic response of exercise cardiolite stress test have resolved after the procedures. Therefore, we considered our intervention to be successful.

3. Discussion

CAF is a rare condition of a direct communication between a coronary artery and one of the cardiac chambers, the coronary sinus, the superior vena cava, or the pulmonary artery. It has been reported that incidental diagnostic rate in adults was about 0.1% in patients undergoing invasive cardiovascular imaging [1]. Therefore, information regarding CAFs in adults is limited. The PA is the most common
multiple CAFs and multiple large branches in the CAFs; absence of extreme vessel tortuosity; and safe accessibility to the coronary artery, were recommended for elective transcatheter closure of the CAF [9]. Based on these reports, we took this case as suitable and succeeded in the coil embolization without complications.

The size of the implanted coils has to exceed the diameter of the CAFs by at least 30% to prevent coil reposition or migration. Gianturco coils, platinum micro coils, independent silicon, latex balloons, or a combination of coils and balloons can be used as the CAF embolization materials [6,7]. Of these, platinum coil, which was deployed in this case, is used most often recently. Although up to 20 coils have been used in other institutions [4], an effective result was achieved with seven coils for two CAFs in this case. There was no coil repositioning and migration during procedures.

In this case, our patient had exertional chest pain or dyspnea due to CAFs without atherosclerotic coronary artery disease. We therefore decided on transcatheter closure of the CAFs. The procedures were uncomplicated. The patient’s chest pain or dyspnea resolved after the procedure. Transcatheter closure of the CAF is feasible and safe in the anatomically suitable vessels. We can say that occlusion by transcatheter coil embolization for the CAF should be considered more often, because it is low cost with a short postprocedural hospital stay and minimal period of rehabilitation, low risk of myocardial damage, and advantage of avoiding a thoracotomy and cardiopulmonary bypass compared with traditional operation.

References