

Coil migration during coronary artery fistula transcatheter embolization



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ABSTRACT

Introduction: Coronary artery fistula (CAF) transcatheter coil embolization is very effective in treating symptomatic coronary fistula and has many advantages compared to the surgical approach. Although this procedure is considerably safe, some life-threatening complications, including vessel rupture, coil migration and death, could still happen. We reported an example case of coil migration into the left anterior descending (LAD) artery during transcatheter CAF embolization.

Case Description: A 61-year-old man reported recurrent episodes of typical chest pain and a history of inconclusive exercise tests. Computed tomography (CT) angiography revealed a considerable medium size complex coronary fistula from proximal LAD to main pulmonary artery (MPA), which could cause coronary steal syndrome. The patient then underwent CAF transcatheter coil embolization with 3 pushable coils. Upon delivery of the last coil, the coil suddenly migrated into proximal LAD and made the patient feel chest pain with slight ST depression on electrocardiogram (ECG) monitor lead. This coil migration was treated with a coronary stent to pin the coil into the ostial CAF and coronary vessel wall. After the procedure, the chest pain disappeared, and the ST segment on ECG resolved back to baseline.

Conclusion: Coil migration is one of the potentially life-threatening complications during transcatheter CAF coil embolization. Careful preparation in choosing the closure technique, selecting coil size, determining the landing zone and using a detachable coil in high-risk CAF anatomy is mandatory to prevent this event.

Keywords: Coil migration, coronary artery fistula, transcatheter coil embolization.

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INTRODUCTION

A coronary artery fistula (CAF) is an aberrant connection that bypasses the capillary bed and connects one or more coronary arteries directly to a heart chamber or major thoracic veins¹ The majority of CAFs are congenital and are unintentionally discovered when undergoing coronary angiography or noninvasive cardiac imaging. Nevertheless, they are more frequently observed after the insertion of an intracardiac device, cardiac surgery, myocardial biopsy, or direct chest damage.^{2,3}

The treatment plan for individuals with CAF is determined by the size of the fistula, if symptoms are present, the architecture of the fistula, the patient's age, and whether any accompanying cardiovascular problems are present. The American College of Cardiology and American Heart Association recommend interventional management for large CAF regardless of the presence of symptoms, as

well as for small to moderate-sized fistulas with symptoms like myocardial ischemia, arrhythmia, ventricular dysfunction, and endarteritis. Surgical ligation and percutaneous transcatheter closure are two possible treatments.^{3,4}

An invasive approach with lower risks than surgery is transcatheter closure (TCC). The main benefits of TCC over surgery include avoiding cardiac bypass or median sternotomy and the associated iatrogenic risks, lowering treatment costs, reducing recovery time and morbidity, and improving aesthetic outcomes—a key factor, particularly in young patients. A variety of occlusion coils, including as stainless steel or platinum coils, umbrella-specific devices, detachable balloons, vascular plugs, and coated stents are among the procedures used for TCC of CAF.^{2,5}

One of the most popular techniques for percutaneous CAF closure, particularly in small to moderate diameters, is coil embolization. Transient arrhythmias, coil

migration into the main coronary artery or recoil into it, which might result in an acute myocardial infarction and, on rare occasions, sudden death, are possible side effects of this procedure.^{5,6}

CASE DESCRIPTION

A 61-year-old male came to our hospital with a chief complaint of recurrent chest pain that has become more progressive since last month. Chest pain was typical for angina with radiation into the left arm and jaw. Chest pain duration of around 15 minutes is usually felt when doing moderate exercise and disappears at rest. The patient didn't complain of breathlessness, lower extremity edema, palpitation or syncope. The patient has a history of diabetes mellitus type II, hypertension and hyperuricemia treated with glimepiride, ramipril and allopurinol. He also had a history of CAF (coronary-pulmonary fistula) and coronary artery disease treated with percutaneous

coronary intervention (PCI) 4 years before admission. There is no history of chronic kidney disease, familial disease or other systemic disorder.

Physical examination revealed that the patient was fully aware and in a fairly sick state overall. Body temperature was 36.4°C, blood pressure was 109/66 mmHg, heartbeat was 72 beats per minute, breathing was 20 times per minute, and oxygen saturation was 98%. No signs of anemia or icterus are seen on head tests, and a neck exam reveals jugular venous pressure of seven cmH₂O without any enlargement of the thyroid gland or local lymph nodes. Examinations of the chest revealed symmetrical shape and movement; tactile fremitus was comparable to normal auscultation for both lungs. There was an ictus cordis in the left midclavicular line but no excitement. First and second heart sounds on heart auscultations are normal. At the upper left sternal boundary, there was a persistent murmur. There was no epigastric discomfort, no palpable enlargement of the liver or spleen, and the abdomen was flat. The bowel sound was also normal. Lower extremities had no edema, and capillary refill time was 2 seconds with equal arterial pulse on both sides of the extremities.

Electrocardiography (ECG) showed sinus rhythm, normal QRS complex axis, 76 beats per minute ventricular rate, and complete right bundle branch block (RBBB). In the laboratory, examination showed a normal level of complete blood count, renal function, liver function, electrolyte and cardiac enzyme. The chest X-ray showed elongation of the aorta with no sign of cardiomegaly. On echocardiography examination, we found normal left ventricular (LV) function with ejection fraction 65%, no sign of regional wall of abnormalities, mild calcification at the aortic valve, mild aortic and pulmonary regurgitation, normal right ventricular function with tricuspid annular plane systolic excursion 2,3 cm. Exercise stress tests were inconclusive due to leg discomfort.

Cardiac computed tomography (CT) revealed a CAF with a single origin from the proximal left anterior descending (LAD) artery and multiple drainage into the main pulmonary artery / MPA

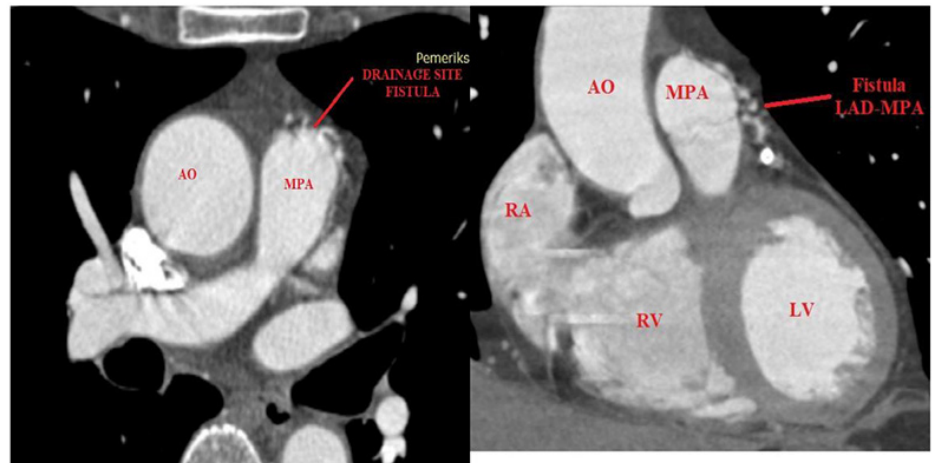


Figure 1. Cardiac CT revealed a coronary fistula from the proximal left anterior descending (LAD) artery to the main pulmonary artery (MPA).

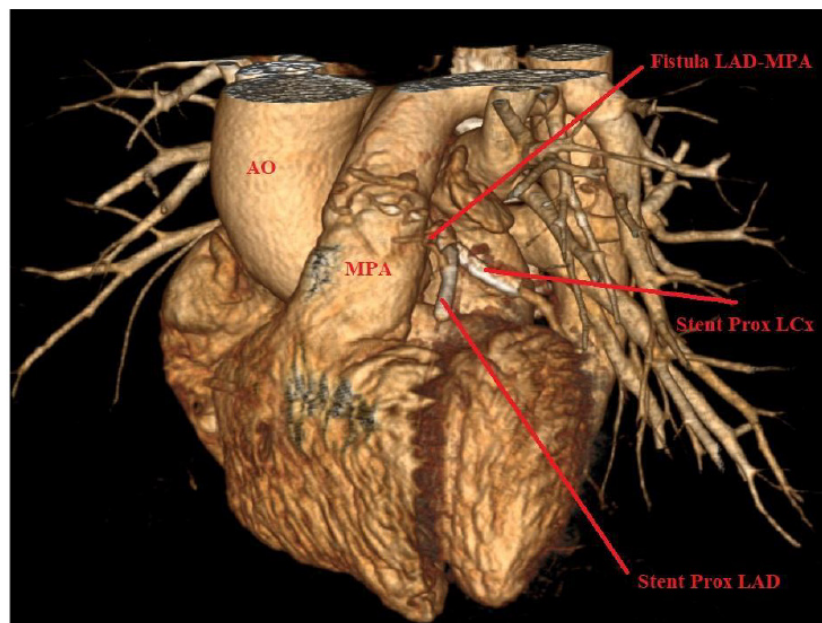


Figure 2. 3D reconstruction of cardiac CT showed a coronary-pulmonary fistula with a single origin and multiple drainage sites.

(Figures 1 and 2). This fistula was classified as complex CAF, Sakakibara Type A, with a diameter of origin 2,3 mm. Cardiac CT also showed no sign of in-stent restenosis (ISR) from previous PCI. On invasive coronary angiography, it showed medium-size CAF at proximal LAD with a diameter of 2.3 mm. Good contrast flow was seen from CAF origin and drainage into MPA. Coronary stents from previous PCI were both patent with no sign of ISR at proximal LAD and proximal left circumflex artery. Because this medium fistula could contribute to

coronary steal syndrome that may cause myocardial ischemia, a decision was made to close this CAF with coil embolization transcatheter technique.

Following the procedure, guide catheter CLS 3.5-6F and guidewire BMW were used to engage the left coronary artery ostium and cross CAF origin. Microcatheter Renegade STC 18 was inserted selectively into a portion of CAF to facilitate coil delivery. Coil embolization was performed using a pushable coil Vort-X 18 and delivered through a microcatheter. Two pushable coil VortX-18 5 mm x 5,5 mm

and 3 mm x 2.5 mm were successfully delivered to the proximal part of CAF, but residual clear contrast flow to MPA still exists due to multiple drainage of this fistula. Upon delivery of the third Vort-X coil, 3 mm x 2,5 mm, the coil suddenly migrated into LAD, causing the patient to have chest discomfort with slight ST depression on the ECG monitor lead (Figure 3). Because our catheterization laboratory lacks a snare or forceps tool to retrieve the coil, the operator deployed a coronary drug-eluting stent (DES) to pin the coil into the ostial CAF origin and the coronary vessel wall. After deployment of the stent, the coil was jailed into the ostial CAF and some parts of the coronary vessel wall (Figure 4). The patient's chest pain disappeared, and the ST segment on ECG resolved back to baseline after the procedure. At the six-month follow-up, the patient no longer complained of chest pain, had no changes on ECG and had good LV function without regional wall abnormalities on echocardiography examination.

DISCUSSION

Reidy et al. reported the first transcatheter closure of CAF in 1983. Later, in 1990, novel methods utilizing spirals that result in fistula thrombosis via the percutaneous method known as coil embolization were tried. Since then, there have been significant developments in interventional devices, including the creation of detachable coils and vascular occluders. Closure aims to stop the passage of fluid through the fistula's body.²

Transcatheter methods decrease possible iatrogenic consequences by avoiding median sternotomy and cardiopulmonary bypass. TCC is a less invasive, less painful, and more effective aesthetic surgery that is also less costly. As a result, the trans-catheter closure is now the preferred option for CAF. It is also achievable in the majority of patients; however, severe vascular tortuosity, numerous drainage sites, and coronary branches at the location of ideal device positioning, as well as the presence of an intracardiac haemangioma, may render this method inappropriate. On the other hand, TCC is preferred when the CAF is proximal and has a single drainage site, a

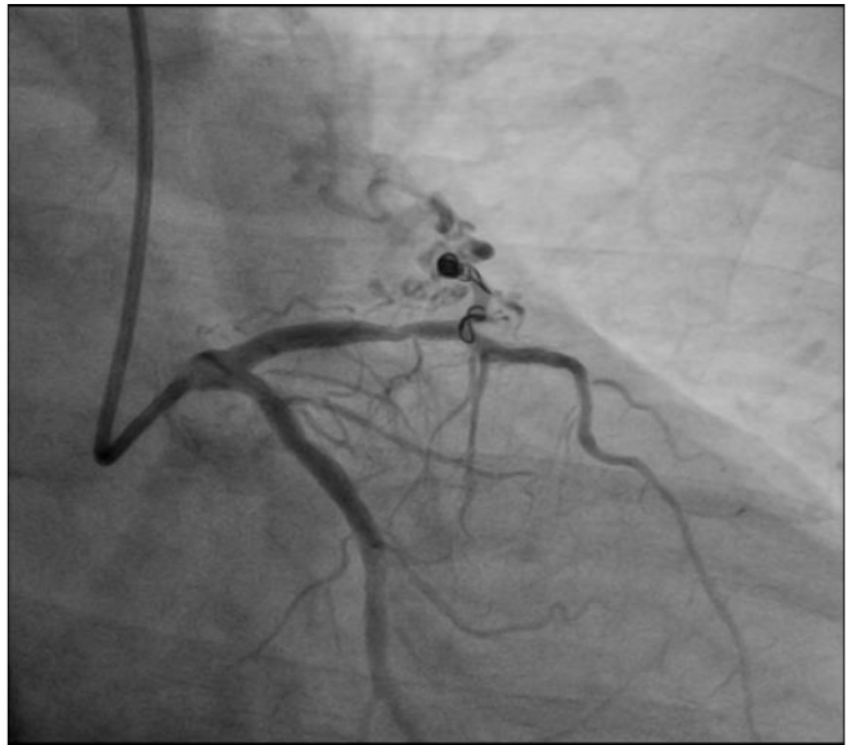


Figure 3. Coil Vort-X 18 3 mm x 2,5 mm migrated into the left anterior descending artery during the procedure

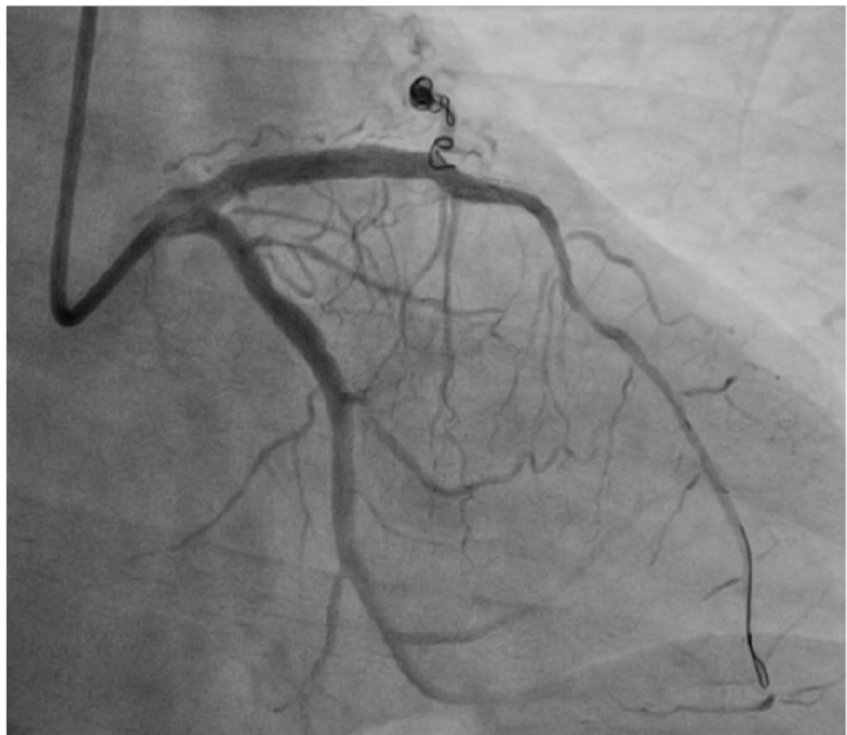


Figure 4. Deploy coronary drug-eluting stent (DES) to pin the migrated coil into the ostium of the fistula and the coronary vessel wall.

non-tortuous vessel, distal narrowing of the CAF with a device for closure that can be accessed, when there are no significant branches that could accidentally embolize,

when there are no other cardiac disorders, and when there is no high risk of surgical complications during the procedure.⁷⁻⁹

The most popular technique for

percutaneous CAF closure, whether using a retrograde or anterograde route, is coil embolization. Coil embolization should not be used when there are several feeds since it is difficult to close the CAF with only one intervention. Coil embolization is not recommended because of distantly situated fistulas, convoluted anatomy, a vulnerable neighboring channel, the requirement for a simultaneous cardiac bypass, and bigger fistulas. TCC coil embolization is marginally inappropriate in this circumstance since the CAF had a single feeder with numerous drains and convoluted morphology.^{5,10}

Metallic wires that are either pushable or detachable and vary in size, form, and hardness make up coils. Due to its ability to adapt to the shape of the vessel, stainless steel or platinum coils are frequently employed in the TCC of CAF. Helical coils are frequently employed and can be piled to anchor. The most popular coils are covered in fibers to make them more thrombogenic. There are fibers built into the device or not in platinum micro coils. Until a specific site is discovered, electrolytically detachable coils that are simple to extract from the delivery catheter have also been utilized to obstruct CAF. The benefit of electro-thrombosis, which aids in the fistula's closure, makes these coils more costly but the coil of choice for bigger fistulas where the danger of device migration and/or embolization is higher. Both electrolytically detachable coils and interlocking detachable coils benefit from being retracted and repositioned prior to delivery. Unlike conventional pushable platinum or steel coils, which cannot be recovered or retracted before deployment, these coils may be readily maneuvered until the ideal position is reached.^{3,5,11}

Even though coil embolization is less intrusive than surgery, it still carries the risk of potentially fatal side effects such as coil migration, distal embolization, or continued leakage or recanalization of fistulas, particularly in patients with large fistulas and high-flow shunts. Coil migration into a major coronary artery can result in acute myocardial infarction, whereas migration into a pulmonary artery can result in potentially fatal consequences such as pulmonary embolism.^{5,12}

In 45 patients who had 56 CAF

closures, a recent El Sabawi et al. research revealed a 90% acute procedural success rate. Device migration occurred in 3 patients, cerebral hemorrhage in 1, and MI in 4 patients, among other complications. Patients receiving pushable coil therapy were the subjects of all device embolization instances. The use of covered stents or stagnant flow following the closure of large fistulas were factors in MI occurrences. Armsby et al. found that 82% of 33 patients in a different series had effective closure. There were five instances of transient ST-T-wave alterations, four instances of transient arrhythmia, one instance of coronary spasm, one instance of fistula dissection, and one instance of unrecovered device embolization among the complications.^{7,13}

It is crucial to carefully assess the fistulas' origin, course, and drainage location, choose coils of the ideal size, and only release them at the vessel's curve in order to prevent the aforementioned difficulties. Always 30% larger than the artery to be blocked, the coil size. In this instance, the coil migrated into the coronary artery and decreased distal coronary flow resulted in myocardial ischemia. Even though a sufficient ring size was chosen, this migration happens because the CAF's slightly unfavorable architecture for coil embolization and the coil's inadequate landing zone due to the lack of a narrowing point on the proximal CAF before it was separated into several tiny branch feeders.^{3,5}

When coil or device migration occurs, retrieval can be achieved percutaneously using snare devices such as En-Snare and Goose Neck snare.^{3,14} Due to a lack of snare devices, we deployed a coronary drug-eluting stent into a migrated coil and pin it to the ostium of CAF and the coronary vessel wall.

After intervention, the CAF follow-up algorithm is only partially effective. Due to the risk of post-procedural recanalization or residual flow, persistent coronary artery dilations, late thrombosis, and myocardial ischemia, long-term follow-up is crucial. Therefore, even if the majority of patients experience a symptomatic recovery following intervention, they should still be monitored. The follow-up should include clinical examination using a chest x-ray,

EKG, and echocardiography. Myocardial perfusion scintigraphy should be carried out when myocardial ischemia is thought to be present.⁵ After six months of post-procedure follow-up, there was no evidence of cardiac ischemia, recanalization, or thrombosis in our patient.

CONCLUSION

One potential life-threatening complication during transcatheter coil embolization of CAF is coil migration because it can lead to pulmonary or systemic embolism and myocardial infarction. Careful preparation in choosing the closure technique, selecting coil size, determining the landing zone and using a detachable coil in high-risk CAF anatomy is mandatory to prevent this unwanted event.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ETHICAL CONSIDERATION

This case report has received informed consent from the patient. The Ethical Committee has approved this study for Sam Ratulangi University.

FUNDING

No specific funding was received for this study.

AUTHOR CONTRIBUTION

Each author has contributed equally to this manuscript from the concept until manuscript preparation.

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