Transcatheter Coil Embolization of a Left Anterior Descending Coronary Artery Fistula: A Case Report

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ABSTRACT

Coronary artery fistula (CAF) is a rare anomaly involving an abnormal communication between a coronary artery and a cardiac chamber or great vessel. Clinically significant fistulas may lead to myocardial ischemia, heart failure, or arrhythmias. This report describes a case of a left anterior descending (LAD) artery fistula successfully treated with transcatheter coil embolization. The procedure was performed via femoral arterial access under fluoroscopic guidance using a microcatheter system. A stepwise distal-to-proximal coil deployment technique was applied to achieve optimal packing. Complete angiographic occlusion of the fistula was obtained without compromising native coronary flow, and no intra- or post-procedural complications occurred. This case highlights that transcatheter coil embolization is a safe and effective treatment option for selected CAF patients. Careful anatomical evaluation, appropriate device selection, and meticulous procedural technique are essential to ensure successful closure and preservation of coronary perfusion.

Keywords

Coronary artery fistula; Coil embolization; Transcatheter closure; LAD fistula; Coronary anomaly.

Contribution to the literature

This case report contributes to the growing body of evidence on the management of coronary artery fistulas, particularly those arising from the left anterior descending artery. It illustrates how a thoughtful, step-by-step transcatheter coil embolization approach can successfully achieve complete closure without compromising normal coronary blood flow. By detailing the procedural strategy and decision-making process, this report highlights the importance of careful anatomical evaluation and tailored device selection in real-world practice. Overall, it reinforces the role of transcatheter coil embolization as a safe and effective treatment option in appropriately selected patients.

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1 Introduction

Coronary artery fistula (CAF) is a rare congenital or acquired anomaly defined by an abnormal communication between a coronary artery and a cardiac chamber or great vessel, bypassing the myocardial capillary bed. The reported prevalence ranges from 0.002% in the general population to approximately 0.1-0.2% among patients undergoing coronary angiography [1, 2]. Although many fistulas remain clinically silent, hemodynamically significant lesions may lead to coronary steal, myocardial ischemia, heart failure, arrhythmias, pulmonary hypertension, or infective endocarditis [1-3].

The clinical presentation depends largely on fistula size, origin, drainage site, and associated hemodynamic burden. Small fistulas are often discovered incidentally, whereas larger fistulas may

produce symptoms related to volume overload or ischemia [4]. Historically, surgical ligation was considered the standard treatment for significant CAFs. However, advances in interventional cardiology have shifted management toward transcatheter techniques, which offer lower procedural morbidity and shorter recovery time [5, 6].

Transcatheter closure techniques include coil embolization, vascular plugs, and occluder devices, selected according to the anatomical characteristics of the fistula. Coil embolization remains one of the most widely used methods, particularly for small to medium-sized fistulas with a suitable tubular morphology [6, 7]. We present a case of successful transcatheter coil embolization of a coronary artery fistula arising from the left anterior descending artery.

2 Case Presentation

A 71-year-old woman was referred to our hospital for further management of a coronary artery fistula. The patient had a history of hypertension and type 2 diabetes mellitus. She initially presented in 2024 with progressive exertional dyspnea and easy fatigability during moderate to heavy physical activity. There was no history of resting chest pain, palpitations, syncope, or orthopnea. Her symptoms were consistent with Canadian Cardiovascular Society (CCS) class II–III angina equivalent.

Previous diagnostic coronary angiography revealed a coronary artery fistula originating from the proximal left anterior descending artery, with mild non-obstructive coronary artery disease in other vessels. The patient was subsequently scheduled for transcatheter fistula closure.

The procedure was performed under local anesthesia with the patient in the supine position. Continuous electrocardiographic and hemodynamic monitoring was maintained throughout the intervention. Baseline vital signs before the procedure were blood pressure 166/88 mmHg, heart rate 81 beats per minute, and oxygen saturation 99% on room air.

After sterile preparation of the bilateral inguinal regions, local anesthesia with 2% lidocaine was administered in the right groin. Vascular access was obtained via the right femoral artery using the Seldinger technique, and a 7F arterial sheath was introduced over a 0.035-inch guidewire. A 7F BL 3.0 guiding catheter was advanced to the ascending aorta and engaged at the ostium of the left main coronary artery. Diagnostic coronary angiography was performed in multiple projections to delineate the anatomy of the fistula (**Figure 1**). Systemic anticoagulation was achieved with intravenous heparin (7000 units).

A Runthrough NS Hypercoat guidewire was advanced into the fistulous tract, followed by selective cannulation using a Headway 1.7F microcatheter (**Figure 2**). Initial embolization was attempted using a MicroPlex HyperSoft 3D coil (5 × 10 cm), which did not produce adequate occlusion. Therefore, a stepwise embolization strategy was employed. A MicroPlex HydroSoft 3D coil (3 mm x 8 cm) was successfully deployed within the fistula, followed by angiographic confirmation and detachment (**Figure 3**). Additional coils were then sequentially deployed to increase packing density, including a MicroPlex HyperSoft 3D coil (5 mm x 10 cm) and two helical coils measuring 4 mm x 8 cm and 2 mm x 8 cm, respectively, positioned proximally within the fistulous tract (**Figure 4**).

Final angiographic assessment demonstrated complete occlusion of the fistula without compromise of the native coronary branches (**Figure 5**). The procedure was completed without intra or post-procedural complications. The patient remained hemodynamically stable after the procedure and was transferred to the ward for further monitoring and continuation of optimal medical therapy.

3 Discussion

Coronary artery fistulas represent a rare but clinically significant subset of coronary anomalies. The pathophysiological hallmark of CAF is the diversion of coronary blood flow into a low-resistance chamber or vessel, producing a coronary steal phenomenon and potentially resulting in myocardial ischemia or volume overload [1, 3]. The clinical spectrum ranges from asymptomatic incidental findings to severe complications such as heart failure, arrhythmias, pulmonary hypertension, or infective endocarditis [4, 8].

Management strategies for CAF depend on symptomatology, fistula size, and hemodynamic significance. Current evidence suggests that symptomatic fistulas, large shunts, or those associated with complications should undergo closure, either surgically or via a transcatheter approach [5, 6]. In recent years, transcatheter closure has become the preferred strategy in anatomically suitable cases due to its minimally invasive nature, reduced hospital stay, and favorable clinical outcomes [6, 9].

Coil embolization remains one of the most commonly used transcatheter techniques for CAF closure, particularly in fistulas with small to moderate diameters and a suitable tubular configuration [6, 7]. The fundamental principle involves selective delivery of coils into the fistulous tract to induce thrombosis and achieve permanent occlusion [7]. Optimal results are achieved when coils are deployed at the distal segment of the fistula or near the drainage site, followed by sequential packing in a distal-to-proximal fashion. This strategy reduces the risk of coil migration and improves the likelihood of complete occlusion [7, 10].

In the present case, a stepwise distal-to-proximal packing technique was employed using coils of varying sizes and configurations. The initial coil did not achieve adequate occlusion, necessitating the use of additional coils to increase packing density. This approach is consistent with contemporary interventional practice, particularly in fistulas with moderate flow or elongated anatomy [7, 10]. Several studies have reported high procedural success rates for transcatheter CAF closure. In modern series, technical success exceeds 85–90%, with low complication rates in appropriately selected patients [9, 11]. Furthermore, closure of the fistula has been associated with improved coronary perfusion and resolution of the coronary steal phenomenon [12].

Despite its effectiveness, coil embolization is not without risks. Potential complications include coil migration, inadvertent occlusion of adjacent coronary branches, myocardial infarction, thrombosis of the donor artery, and fistula recanalization [7, 11]. Therefore, careful anatomical assessment, precise catheter positioning, and appropriate coil sizing are essential to ensure procedural safety and efficacy.

In this case, successful occlusion was achieved without procedural complications, highlighting the feasibility and safety of coil embolization in a suitably selected LAD fistula. The favorable outcome underscores the importance of individualized treatment planning, meticulous technique, and appropriate device selection.

4 Conclusion

Coronary artery fistula is an uncommon coronary anomaly with a wide spectrum of clinical presentations, ranging from incidental findings to significant hemodynamic compromise. Early recognition and appropriate anatomical assessment are essential to guide optimal management. In symptomatic or hemodynamically significant fistulas, transcatheter closure has emerged as the preferred therapeutic strategy in anatomically suitable cases due to its minimally invasive nature and favorable clinical outcomes.

This case demonstrates that transcatheter coil embolization is a safe, effective, and reproducible technique for the treatment of coronary artery fistulas arising from the left anterior descending artery. A meticulous procedural strategy, including selective catheterization, appropriate coil sizing, and a distal-to-proximal packing technique, is critical to achieving complete occlusion while preserving native coronary perfusion.

Successful closure without procedural complications in this case underscores the importance of individualized anatomical assessment and device selection. Transcatheter coil embolization should be considered a first-line therapeutic option for appropriately selected coronary artery fistulas, offering excellent procedural success with low morbidity and rapid recovery.

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