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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Percutaneous Coil Embolization of Coronary Artery Fistula Complicated by Refractory Ventricular Fibrillation and Cardiogenic Shock

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ABSTRACT

We present a case of a 56-year-old patient with a symptomatic right coronary artery to pulmonary artery fistula who underwent coil embolization. Post-procedure, the patient developed ventricular fibrillation that was refractory to antiarrhythmic medications and numerous attempts at defibrillation. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2022;4:715–718) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 56-year-old man with a past medical history of diabetes and hypertension presented with worsening dyspnea and chest pain on exertion for the past 3 months

PAST MEDICAL HISTORY

The patient had a history of type 2 diabetes mellitus, essential hypertension, morbid obesity, and symptomatic bradycardia with complete heart block and syncope. A dual-chamber pacemaker was implanted 2 years ago.

DIFFERENTIAL DIAGNOSIS

Differentials included acute coronary syndrome, pulmonary hypertension, obesity hypoventilation syndrome, obstructive sleep apnea, or pulmonary embolism.

LEARNING OBJECTIVES

- To recognize complications of coil recoiling and using mechanical support to abort RVF.

INVESTIGATIONS

A transthoracic echocardiogram showed normal left ventricular (LV) systolic and diastolic function, no significant valvular abnormality, and calculated pulmonary artery system pressure of 40 mm Hg.

An adenosine nuclear stress test was performed. No changes on electrocardiogram were noted with a baseline atrial paced rhythm; however, he developed profound shortness of breath and chest pressure typical of his symptoms. He was sent to the emergency room with ongoing chest discomfort and diaphoresis. Stress imaging was not completed because of ongoing chest pain.

The patient had no pertinent findings on the examination. No murmurs were audible. The 12-lead electrocardiogram showed an atrial paced rhythm with no ST-segment or T-wave changes. Three sets of troponins obtained 8 hours apart were normal.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

CAF = coronary artery fistula

CPR = cardiopulmonary resuscitation

LV = left ventricular

RCA = right coronary artery

RVF = refractory ventricular fibrillation

VF = ventricular fibrillation

A coronary angiogram was performed urgently showing a right coronary to pulmonary artery fistula (**Figure 1,** Videos 1A and 1B). Differentials were discussed. Chest computed tomography showed no pulmonary embolus and normal caliber pulmonary artery. The fistula was not clearly seen on the computed tomography of the chest. It was unclear if his symptoms were related to the fistula; however, there had been no change in his weight or sleep apnea symptoms, and given the angina he experienced with stress testing, we discussed the closure of the fistula, as it may be causing coronary steal. Initially referred for surgical ligation; however, given his morbid obesity, the decision was made to proceed with a percutaneous approach.

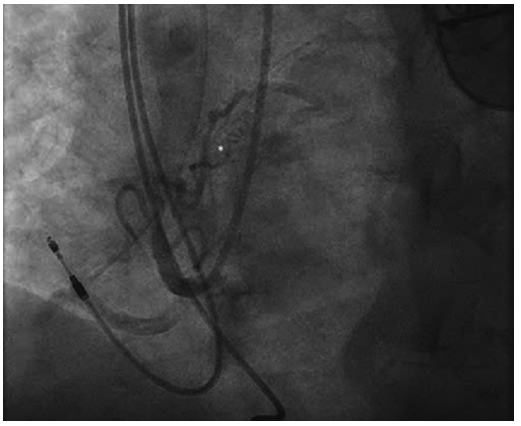
Ultrasound-guided access was obtained to enter with a 6-F sheath in the right radial artery. A JR4 6-F guide was used to engage the right coronary artery (RCA). A 0.014-inch wire was advanced into the conus branch and a Lantern (Penumbra) microcatheter was advanced over the 0.014-inch wire to the apparent vessel. The wire was removed and a 4-mm POD3 coil (Penumbra) was advanced through the microcatheter (Video 2). After coil deployment and release, a selective coronary angiography was performed (**Figure 2A**). It appeared occluded with the trivial flow into the conus vessel (**Figure 2B,** Video 3). Subsequently, the coil was released.

MANAGEMENT (MEDICAL/INTERVENTIONS)

The patient complained of chest pain 30 minutes after closure and was given nitroglycerin. He was taken to the step-down unit for recovery. Two hours later, he developed cardiac arrest with ventricular fibrillation (VF) and respiratory failure requiring intubation. Chest compressions were immediately initiated with the advanced cardiac life support protocol. Direct current cardioversion using 200 J of biphasic energy was administered; however, he initially failed to maintain sinus rhythm. He converted to normal sinus rhythm for a few seconds and then reverted back into VF despite amiodarone and lidocaine. The patient received a total of 18 shocks and multiple rounds of epinephrine per the advanced cardiac life support protocol and cardiopulmonary resuscitation (CPR) for 30 minutes. Dual sequential defibrillation was also attempted. He was taken emergently to the cardiac catheterization lab with CPR in progress.

On the table, he had a recurrence of VF requiring defibrillation. Access to the right femoral artery was obtained during CPR and between defibrillations. LV angiogram showed an ejection fraction of 20%. A mechanical support device was quickly inserted using an Abiomed Impella CP device (**Figure 3,** Video 4). After initiation of mechanical support, he was shocked again and successfully maintained a sinus rhythm.

FIGURE 1 Coronary Angiogram of the Right Coronary Artery



Left anterior oblique view, right coronary artery to pulmonary artery fistula marked by **asterisk**.

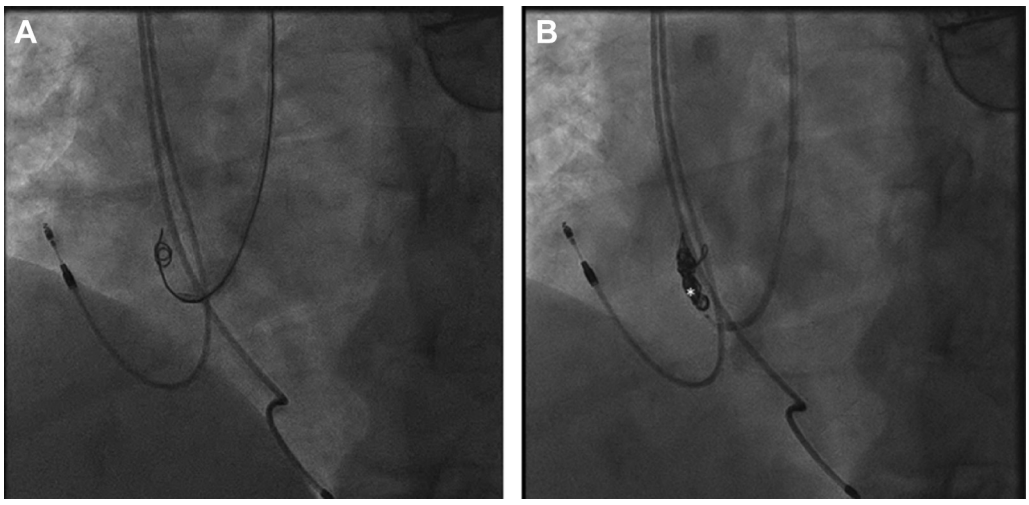
Coronary angiogram of the RCA showed an occluded conus branch but TIMI (Thrombolysis In Myocardial Infarction) flow grade 3 in native RCA (Video 5).

He was subsequently admitted to the intensive care unit and, an hour later, given his normal mental status, was extubated. The mechanical support device was removed the following day after an echocardiogram showed normal LV function. The patient was subsequently discharged home the following day.

DISCUSSION

Coronary artery fistula (CAF) is a coronary abnormality that could be congenital or acquired. It accounts for 0.27% to 0.40% of all congenital cardiac defects.[1] Based on the diameter of the fistula, CAFs are classified as small, medium, and large. Classification is based on comparing the diameter of the fistula to the largest coronary vessel not feeding the fistula. CAFs <1, ≥1 to 2, and >2 times the diameter of the largest coronary vessel are known as small, medium, or large fistulas, respectively. Although small CAFs likely close over time, symptomatic medium CAF or a large CAF fistula may require a surgical or transcatheter approach.[2] Currently, no criteria are

FIGURE 2 Coil Deployment



(A) Left anterior oblique view, deployment of coils. **(B)** Left anterior oblique view, closure of the right coronary artery conus branch to pulmonary artery fistula with a coil.

established regarding the closure of CAFs. The proposed indications for closure of symptomatic medium or large CAFs are evidence of ischemia in the territory of the feeding artery, CAF-related arrhythmias, endarteritis, rupture of the vessel, enlargement of the cardiac chambers, or ventricular dysfunction. In recent studies, arrhythmias were the most common intraprocedural or postprocedural complication of transcatheter closure of CAF.[2]

We present a case of a successful rescue of cardiogenic shock and refractory ventricular fibrillation (RVF) after percutaneous closure of a CAF. To the best of our knowledge, this is the first reported case of RVF after CAF closure rescued with mechanical support.

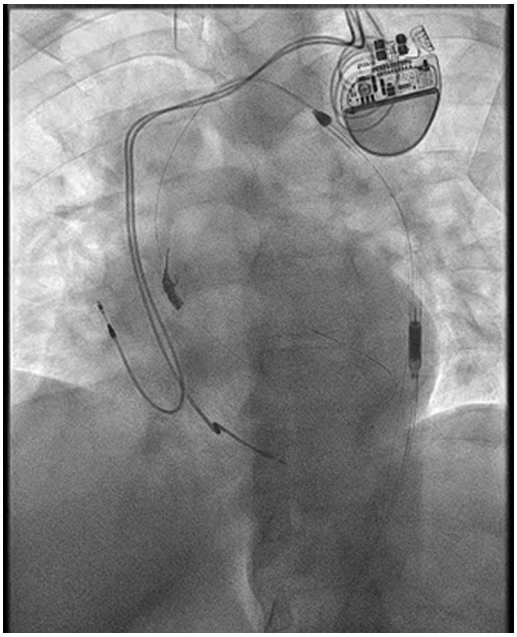
Post-procedure myocardial infarction is a known complication of fistula closure. The fistula branch also supplied the sinoatrial node branch or the right atrial branch coming off the RCA.

RVF has been defined as VF resistant to at least 3 defibrillation attempts, 300 mg of amiodarone, and >10 minutes of CPR.

RVF is known to occur acutely after myocardial infarction.[3] Coagulative necrosis, due to sustained ischemia, histopathologically occurs within 30 to 40 minutes.[4] Electrical storm after conus branch occlusion has been described after a percutaneous intervention of the ostial RCA.[5] VF is also known to occur due to unintentional subselective angiography or catheter engagement of the conus branch during cardiac catheterization.

VF secondary to myocardial infarction can transiently cause depressed LV systolic function and cardiogenic shock, leading to worsening ischemia and recurrent VF causing a vicious cycle.[4] In our case, once mechanical support was initiated, and the LV was mechanically unloaded, there were no further episodes of VF. Mechanical support may have disrupted

FIGURE 3 Insertion of Heart Pump Device



this vicious cycle. Mechanical support for recurrent VF has been reported, albeit with intra-aortic balloon pumps.[6] The antiarrhythmic ibutilide has been used successfully for RVF and electrical storm.[7] Mechanical support with the heart pump device has been successfully used during CPR and ventricular arrhythmias with a 30-day survival of 45.7%.[8] In our case, no further arrhythmias occurred after mechanical support was initiated. There was rapid neurological recovery and no neurological sequelae, suggestive of adequate perfusion with CPR during RVF events.

FOLLOW-UP

An echocardiogram at 6 months' follow-up showed stable LV ejection fraction with no recurrence of symptoms.

CONCLUSIONS

RVF is a rare complication after acute myocardial infarction and has not been described after coil embolization. Preservation of the conus branch should be considered when closing fistulas that originate off of the conus branch of the RCA. Mechanical support should be considered early during RVF.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS defibrillation, embolization, fistula, right coronary artery, ventricular fibrillation

APPENDIX For supplemental videos, please see the online version of this paper.