

# Frequent premature ventricular ectopic beats successfully treated by embolization of two coronary artery fistulas



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## Introduction

Catheter ablation has become the cornerstone of therapy for idiopathic premature ventricular complexes (PVCs).<sup>1</sup> Effectiveness, however, is dependent on the exact localization of the ectopic beats, with very high success ratios reported for PVCs arising in the right ventricular outflow tract (RVOT) or within the fascicular branches.<sup>2,3</sup> We present a case where the focus of the PVC seemed to originate in the outflow tract region. Ablation was, however, only partially successful. After embolization of 2 large coronary fistulas, which were noted during routine coronary angiography, the PVCs disappeared and the patient's symptoms resolved.

## Case report

A 68-year-old man was referred for catheter ablation of frequent ventricular ectopy because of complaints of palpitations, a continuous murmur in the chest, fatigue, and discrete exertion intolerance. On 24-hour Holter monitoring, there were more than 18,000 PVCs despite therapy with a low dose of propranolol. The morphology of the monomorphic PVC showed a left bundle branch block with inferior axis and transition in electrocardiographic lead V<sub>3</sub>, which was suggestive of an origin in the left ventricular outflow tract or the RVOT (Figure 1). Echocardiographic assessment showed normal biventricular function without structural abnormalities. Magnetic resonance imaging of the heart showed no zones of delayed gadolinium enhancement; the right ventricle was slightly enlarged, but there were no other criteria for arrhythmogenic right ventricular cardiomyopathy. Flecainide was added to the therapy and an ablation was planned.

At the time of the electrophysiological study, there was no spontaneous ventricular ectopy. During administration of adrenaline, 3 slightly different PVCs appeared with a

## KEY TEACHING POINTS

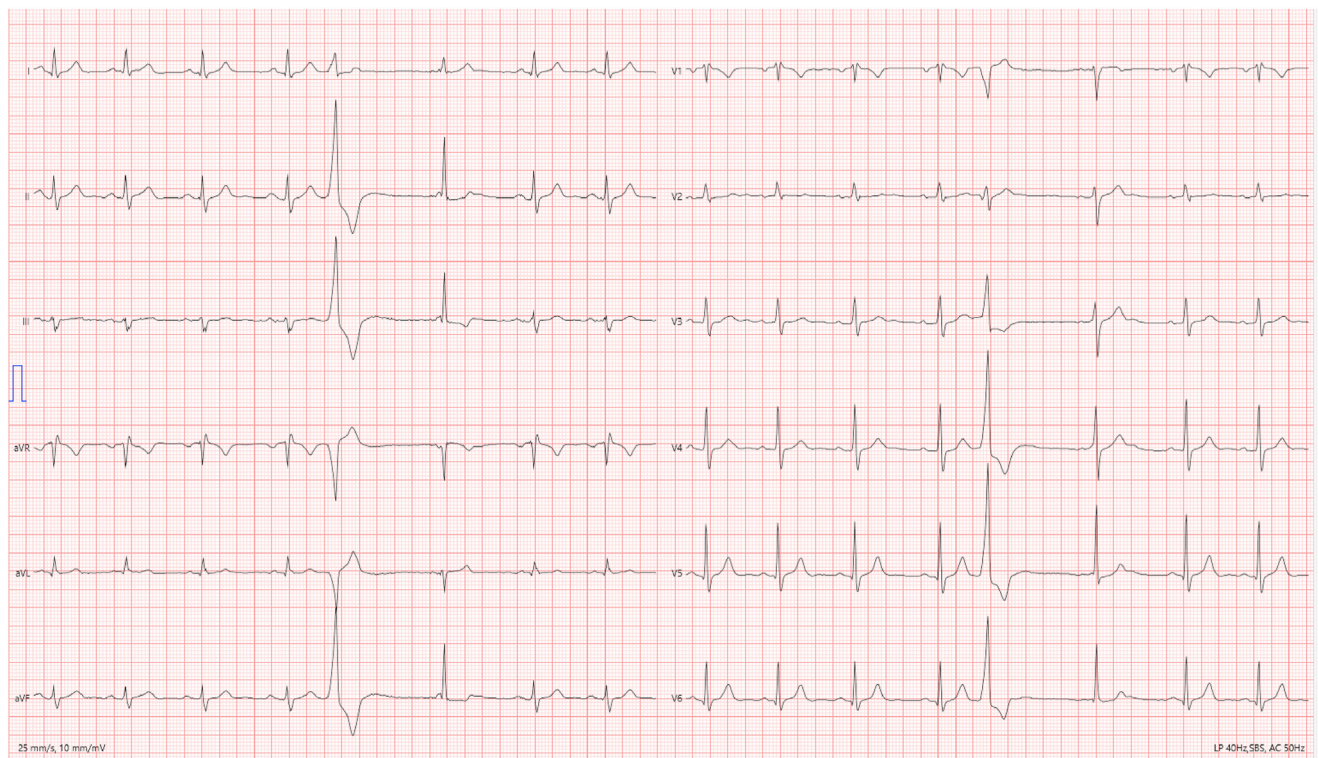
- Catheter ablation of premature ventricular complexes (PVCs) arising from the outflow tract region yields good results; it is, however, not always successful.
- Coronary artery fistulas to the pulmonary artery are a rare finding. Usually, they are not related to the presence of PVCs.
- This is the second case report where the obliteration of coronary artery fistulas resulted in a significant reduction of PVCs, and the first one where this has been described in a patient with a prior catheter ablation that was only partially successful, suggesting a possible pathophysiological relationship.

morphology similar to the clinical PVC. The patient was intubated and the most frequent PVC was taken for pace mapping. The best pace mapping localizations showed a poor correlation of 85% at the level of the aortic root, and 84% at the posteroseptal aspect of the RVOT. Ablation in these regions was hence not performed. An infusion with adrenaline was again started, and 2 slightly different morphologies of PVCs were noted that also corresponded to the clinical PVC. Pace mapping of these 2 morphologies showed a better pace map correlation of 97% at the antero-septal aspect of the RVOT, and 93% in a more caudal position. There were not enough spontaneous PVCs to allow activation mapping. Ablation was performed at these 2 regions with a contact force catheter (Thermocool Smart-Touch; Biosense-Webster Inc, Diamond Bar, CA), with a total of 13 ablation applications. Because of lack of a clear endpoint at the end of the procedure, therapy with propranolol and flecainide was continued.

At follow-up, the complaints persisted, and holter monitoring showed persistent frequent PVCs (2077 in 24 hours). A treatment with propafenone and bisoprolol was tried, but

**KEYWORDS** Premature ventricular ectopic beats; Outflow tract; Catheter ablation; Coronary artery fistula; Embolization  
(Heart Rhythm Case Reports 2024;10:706–709)

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**Figure 1** Electrocardiogram showing a premature ventricular complex suspect of an origin in the outflow tract region.

without success. A repeat electrophysiological study was performed under local anesthesia. With administration of isoprenaline, 3 slightly different PVCs occurred, all similar to the clinical PVC. Activation mapping was again not possible. Pace mapping was performed but showed insufficient correlation percentages to perform ablation, with the highest pace correlation of 91% with 1 of the 3 PVCs just underneath the left coronary cusp. The ectopic focus was thought to be deeper in the interventricular aspect of the outflow tract region. Coronary angiography, which is routinely performed in our center at the start of ablation procedures in the outflow tract region to avoid coronary artery complications, showed a large coronary fistula from the left anterior descending coronary artery (LAD) to the pulmonary artery, as well as a large fistula from an atrial branch of the right coronary artery to the pulmonary artery.<sup>4</sup> There was only a slight left-to-right shunt, as was evidenced by right heart catheterization with a Qp/Qs ratio of 1.1.

An embolization of each fistula was planned during separate procedures. A preinterventional coronary computed tomography angiography (CCTA) was performed for better understanding of the anatomy (Figure 2A). In the first procedure, the right coronary artery was cannulated with a 6F Judkins Right guiding catheter (Merit Medical, South Jordan, UT) using a transradial approach. A 4F Tempo Aqua Vertebral catheter (Cordis, Miami Lakes, FL) was placed until the distal part of the fistula over a long floppy guidewire. A vascular Amplatzer plug of 7 mm (Abbott, Lake County, IL) was introduced through this catheter with progressive occlusion of the fistula (Figure 2D–2F). A second procedure

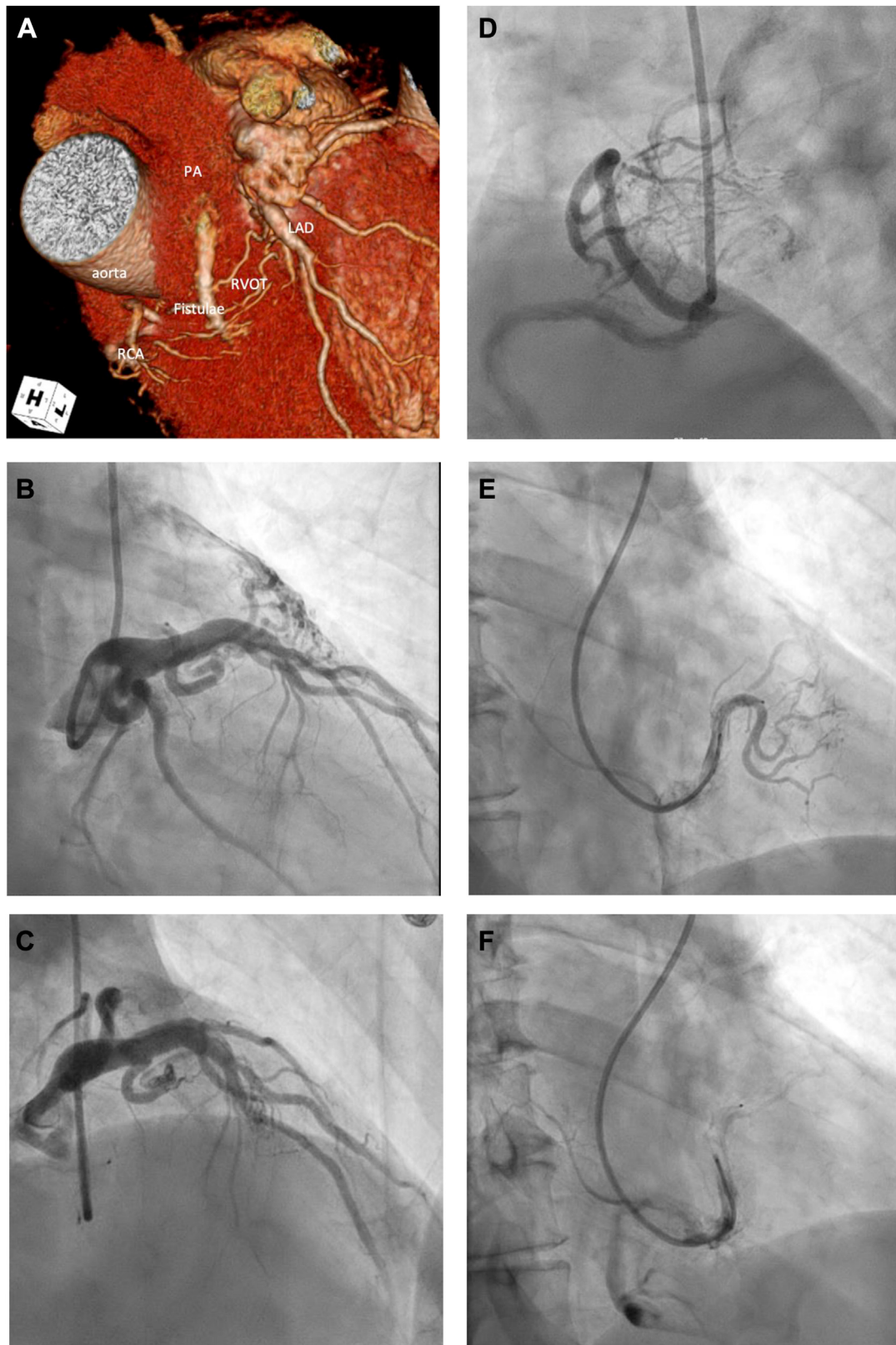
to embolize the fistula from the LAD was not successful because of extensive tortuosity of the fistula. During a third procedure, the fistula could be cannulated with an ASAHI Sion guidewire (Asahi Intecc, Irvine, CA) through an ASAHI Caravel microcatheter (Asahi Intecc, Irvine, CA) using an APT Medical XB4 guiding catheter (APT Medical, Shenzhen, China) with a transradial approach. Four coils could be implanted (Medical Materials 3D-EV3 coils with a size of 3 mm × 4 cm, 2.5 mm × 6 cm, and 2 times 3 mm × 6 cm - Medical Materials Inc, Boyton Beach, FL), with successful occlusion of the fistula (Figure 2B and 2C).

At follow-up, the patient felt as if “reborn.” All his complaints had gone; also, after stopping antiarrhythmic drugs, control holter monitoring without medication showed only sporadic PVCs (128 in 24 hours).

## Discussion

During electrophysiologic study of PVCs with a presumed origin in the outflow tract region, ablation was only partially successful, since the exact ectopic focus could not be established by pace mapping and activation mapping was not possible. During routine coronary angiography, 2 large coronary artery fistulas to the pulmonary artery were noted. We found 1 similar case report from 1979 where a 28-year-old patient presented with a continuous heart murmur and frequent symptomatic PVC, where a single coronary fistula to the pulmonary artery was diagnosed with a left-to-right shunt of 1.1 liter per minute.<sup>5</sup> After surgical obliteration of the fistula, the patient became asymptomatic and





**Figure 2** Preinterventional coronary computed tomography angiography (CCTA) and interventional coronary angiography (ICA) images of the 2 embolization procedures. **A:** A 3-D reconstruction of the CCTA showing both fistulas from the left anterior descending coronary artery (LAD) and right coronary artery (RCA) to the pulmonary artery (PA) (left anterior oblique [LAO] and cranial projection). RVOT = right ventricular outflow tract. **B:** Fistula from the LAD to the PA during ICA (right anterior oblique projection [RAO]). **C:** Final result after coiling of the fistula showing no residual flow in the fistula (RAO). **D:** Fistula from an atrial branch of the RCA to the PA during ICA (LAO). **E:** Plugging of the fistula (RAO). **F:** Final result showing no residual flow in the fistula (RAO). Supplemental videos of the ICA images are provided as online material.

antiarrhythmic drugs could be stopped. Based on these findings, we decided to percutaneously embolize both fistulas, with similar outcome, in our patient.

Coronary fistulas are a rare finding. They have been reported in 0.1%–0.26% of patients undergoing coronary angiography, with an estimated incidence of 0.002% in the general population.<sup>6,7</sup> Bilateral fistulas are even more uncommon occurring in 2%–17% of these patients. In most cases, these fistulas are small, are asymptomatic, and do not require treatment. Sometimes, however, they can cause myocardial ischemia because of a coronary steal phenomenon, heart failure because of a significant left-to-right shunt, or hemopericardium secondary to rupture of a concomitant aneurysm.<sup>7</sup> Valvular complications with infective endocarditis have also been described.

Together with the case report from 1979, this case highlights another type of manifestation of coronary artery fistulas presenting with frequent PVCs with a morphology suggestive of an origin in the outflow tract.<sup>5</sup> Even more so, treatment in both cases with obliteration of the fistulas, with either surgery or an endovascular approach, resulted in resolution of symptoms. The mechanism for idiopathic outflow tract ectopic beats is usually triggered activity.<sup>8</sup> The reason why obliteration of coronary fistulas to the pulmonary artery resulted in a significant reduction of the PVC burden has not been investigated. We hypothesize a mechanical reason where there might be some degree of compression from the fistula on the outflow tract region that could trigger PVCs. Another possibility would be ischemia-induced myocardial injury to the ectopic focus.

**Funding Sources:** None.

**Disclosures:** All authors certify that they have no affiliations with or involvement in any organization or entity with any financial or nonfinancial interest in the subject matter or materials discussed in this manuscript.

## Appendix Supplementary Data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrcr.2024.07.003>.

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