Intraventricular Left Anterior Descending Artery in a Patient with Ventricular Tachycardia – Innocent Bystander with Significant Procedural Implications

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ABSTRACT

Introduction: An intra-right ventricular course of the left anterior descending (LAD) artery is a rare coronary anomaly with uncertain clinical and procedural significance. We describe the use of multimodality imaging to characterize this variant in a patient with ventricular tachycardia and to guide the safe performance of catheter ablation.

Case Presentation: A 46-year-old White woman presented with ventricular tachycardia and was found on coronary computed tomography angiography to have an intraventricular course of the mid LAD through the right ventricular cavity. Multimodality imaging, including coronary computed tomography angiography and stress cardiac magnetic resonance imaging, demonstrated no evidence of obstructive coronary artery disease, myocardial ischemia, structural heart disease, or myocardial scar. She was ultimately diagnosed with idiopathic right ventricular outflow tract ventricular tachycardia and underwent successful catheter ablation.

Discussion: An intra-right ventricular course of the LAD is a rare coronary variant. In a large coronary computed tomography angiography study, this anomaly was identified in less than 1% of patients. Although its clinical significance is not well understood, this anatomic variant can have important procedural implications for ventricular tachycardia ablation.

Conclusions: Multimodality imaging is vital in assessing the clinical significance of an anomalous coronary artery and ensuring the procedural safety of ventricular tachycardia ablation.

INTRODUCTION

A typical left anterior descending (LAD) artery courses along the anterior surface of the heart within the anterior interventricular sulcus. We describe a unique anatomic variant in which the LAD enters the right ventricular cavity without significant intramyocardial bridging.

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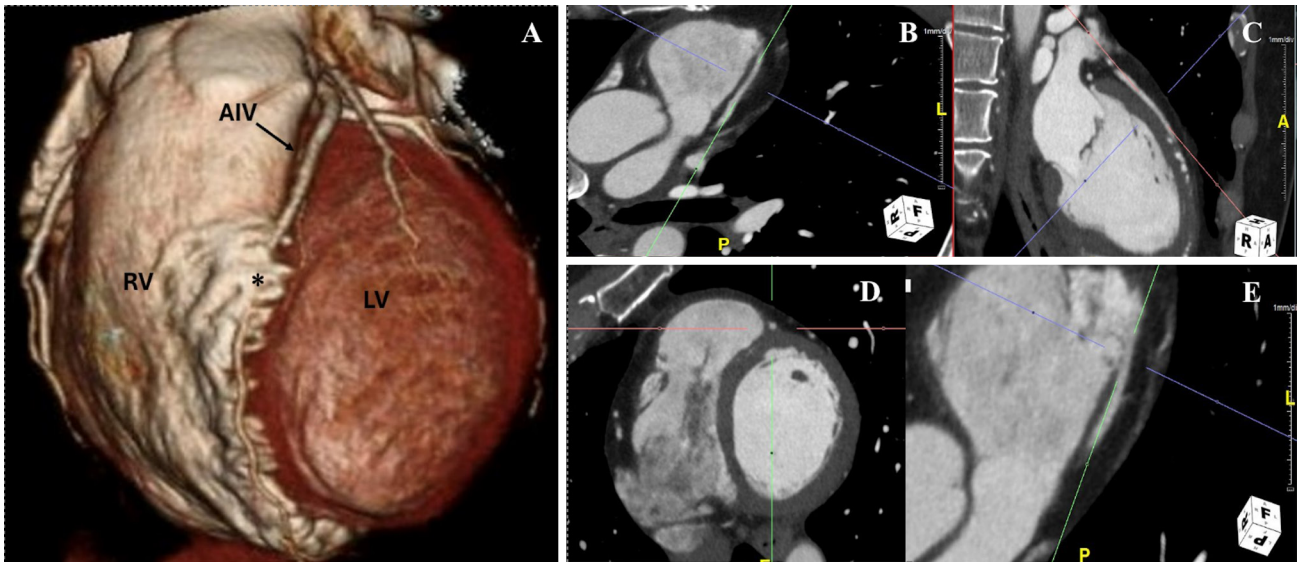
CASE PRESENTATION

A 46-year-old woman with a history of hyperlipidemia presented with palpitations and presyncope. While en route to the hospital, she was found to have sustained monomorphic ventricular tachycardia lasting 45 seconds at a rate of 211 beats per minute (bpm) (Figure 2). On arrival at the emergency department, she was in normal sinus rhythm at a rate of 90 bpm. Her other vital signs and physical examination findings were unremarkable. Initial high-sensitivity troponin T was < 4 ng/L. Chest radiography revealed no acute findings. She was started on metoprolol tartrate and amiodarone.

During her hospitalization, transthoracic echocardiography demonstrated normal biventricular size and function. Given the patient's low-to-intermediate pretest probability of obstructive coronary artery disease, a gated coronary computed tomography angiography (CCTA) was performed. The study was negative for coronary artery disease but revealed a mid LAD coursing through the right ventricular cavity before re-emerging distally into the anterior interventricular groove (Figure 1). Although the inferior axis and left bundle branch block morphology of the ventricular tachycardia suggested a right ventricular outflow tract (RVOT) origin, we pursued a cardiac magnetic resonance imaging (CMR) with regadenoson stress to rule out ischemia from potential compression related to the intraventricular course. CMR was negative for vasodilator-induced ischemia and showed no structural abnormalities of either ventricle or any evidence of myocardial scar. The intraventricular course of the LAD was again identified. Therefore, we diagnosed the patient with idiopathic RVOT ventricular tachycardia.

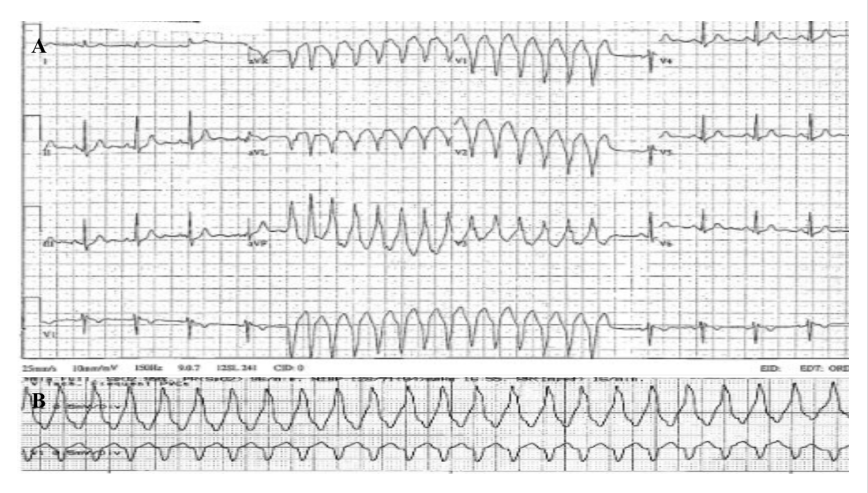
Figure 1. Three-dimensional Gated CCTA Demonstrating the Anomalous Course of the Left Anterior Descending Artery (LAD)



(A) LAD runs in the AIV groove before entering the right ventricular chamber (*) and exits distally in the AIV. Multiplanar reconstruction images show this unique LAD in the orthogonal long axis (B, C) and short axis views (D). The crosshairs have been moved more apically in panel E to demonstrate the LAD inside the right ventricle.
Abbreviations: CCTA, coronary computed tomography angiography; AIV, anterior interventricular; LV, left ventricle.

Given the patient's symptoms and young age, we pursued catheter ablation of the ventricular tachycardia. Based on preprocedural imaging, there was concern that the unusual trajectory of the LAD would be in proximity (<5 mm) to the suspected ventricular tachycardia focus in the RVOT, placing her at increased risk of coronary injury during delivery of radiofrequency ablation lesions.[1] As suspected, the ventricular tachycardia origin was mapped during the procedure to the anterior portion of the RVOT using activation mapping during the arrhythmia and pace mapping. The ablation catheter was maintained at the location of interest, and a coronary angiography confirmed a distance >5 mm between the LAD and ablation site (Figure 3). Radiofrequency ablation was then performed successfully, resulting in suppression of the arrhythmia, and the patient was discharged home.

Figure 2. Twelve-lead ECG and ECG Strip of a Patient With Sustained Monomorphic Ventricular Tachycardia

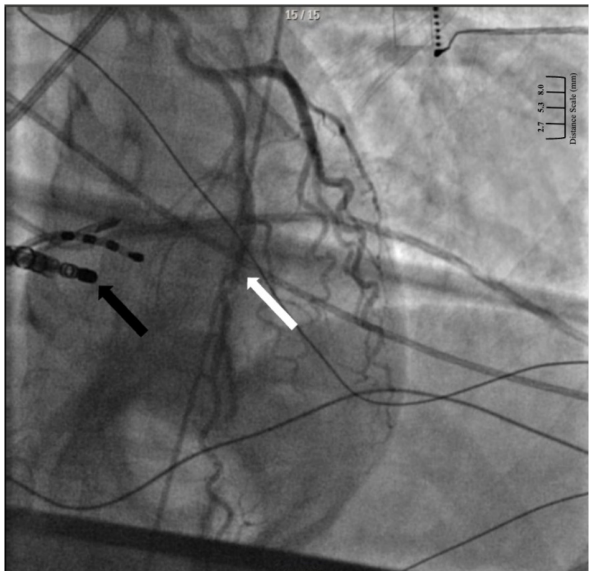


A. 12-lead ECG demonstrating 14 beats of VT with inferior axis and left bundle branch block morphology.
B. ECG strip showing sustained VT for 45 seconds at a rate of 211 beats/minute.
Abbreviations: ECG, electrocardiogram; VT, ventricular tachycardia.

DISCUSSION

An intra-right ventricular course of the LAD is a rare coronary variant. To the best of our knowledge, only 1 study has documented this finding. In a large study of 31748 coronary CTAs, only 17 patients had an intra-right ventricular coronary artery. Interestingly, in all 17 patients, the affected vessel was the LAD.[2] The clinical significance of this anomaly has yet to investigated. Our case highlights the role of multimodality imaging in both diagnosis of RVOT ventricular tachycardia and the procedural safety of ventricular tachycardia ablation.

Figure 3. Fluoroscopic Coronary Angiogram in the Left Anterior Oblique View at 21 Degrees and the Cranial View at 24 Degrees



Left heart catheterization demonstrates the >5 mm distance between the ablation catheter (black arrow) and the left anterior descending artery (white arrow).

CONCLUSIONS

This unique case highlights the utility of multimodality imaging in narrowing the differential diagnosis to RVOT ventricular tachycardia. CCTA was not only effective in ruling out obstructive coronary artery disease, but it was also instrumental in identifying of the intra-right ventricular course of the LAD. Furthermore, stress CMR ruled out cardiomyopathy, myocardial scar, and myocardial ischemia as potential etiologies for ventricular tachycardia. Although this anomaly was unrelated to the patient's ventricular tachycardia, it had important procedural implications, as described above. Knowledge of the anomalous LAD course identified on CCTA prompted coronary angiography and helped guide the procedural team in safely performing ventricular tachycardia ablation.

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