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Journal of Cardiovascular Emergencies 2023
DOI: 10.2478/jce-2023-0006

CASE REPORT

Multimodality imaging-based therapeutic decision in ischemic cardiomyopathy and ventricular tachycardia – a Case Report

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ABSTRACT

Introduction: In patients with ischemic heart disease and coronary chronic total occlusion, it is extremely important to assess the presence of myocardial viability via different cardiac imaging techniques in order to predict a potential functional recovery following revascularization. Multimodality cardiac imaging techniques estimate the risk of sudden cardiac death and personalize patient selection for primary prevention implantable cardioverter-defibrillator therapy. **Case presentation:** A 61-year-old patient with a history of an extensive anterior myocardial infarction with conservative management (8 years before the current presentation, when the coronary angiography revealed two-vessel chronic total occlusion) presented to our outpatient service for fast-paced palpitations at home and fatigue. At the time of the index hospitalization, the patient refused coronary artery bypass grafting. During this period, he did not undergo any cardiovascular evaluation, but he did follow the pharmacological recommendations from the initial hospital discharge. Given the detection of multiple premature ventricular contractions and numerous episodes of nonsustained ventricular tachycardia during this medical visit, a multimodal imaging evaluation was conducted, which further guided the implementation of a personalized therapy. **Conclusions:** In patients with ischemic heart failure and coronary chronic total occlusion, presenting with ventricular tachycardia, the therapeutic decision should be based on the results of a multimodality cardiac imaging evaluation.

Keywords: chronic total occlusion, myocardial viability, ventricular tachycardia, cardiac imaging

ARTICLE HISTORY

Received: January 6, 2023
Accepted: April 11, 2023

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INTRODUCTION

Coronary artery disease or ischemic heart disease comprises a broad spectrum of clinical presentations, conventionally classified into acute coronary syndromes or chronic coronary syndromes, and it is mainly characterized by atherosclerotic plaque formation in the coronary arteries.[1] Commonly, prolonged myocardial ischemia leads to myocyte apoptosis or necrosis and subsequently to collagen deposition (replacement fibrosis). Extensive myocardial fibrosis is linked to both left ventricular systolic dysfunction and increased risk of cardiac arrhythmias. For

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this reason, in the past decades, imaging myocardial fibrosis via different techniques constituted an important area of research and development.[2]

Nowadays, multimodality cardiac imaging techniques allow the characterization of myocardial viability and the noninvasive assessment of myocardial fibrosis. The evaluation of myocardial viability plays a pivotal role in selecting the patients who would potentially benefit from percutaneous revascularization of coronary chronic total occlusion (CTO).

CASE PRESENTATION

We present the case of a 61-year-old patient who presented to our outpatient service for fast-paced palpitations at home and fatigue. He had a history of an extensive anterior myocardial infarction (8 years before the current presentation) with conservative management. The coronary angiography revealed severe two-vessel coronary artery disease (CTO of the mid-anterior descending artery and of the proximal right coronary artery) at that time, which led to a conservative management, as the patient refused the coronary artery bypass grafting. Eight years after the acute event, he presented with New York Heart Association (NYHA) class II heart failure symptoms. Throughout this time, he followed the therapeutic recommendations from the initial hospital discharge but did not undergo any further cardiovascular evaluation. Home medication consisted of acetylsalicylic acid, atorvastatin, and carvedilol. Admission examination revealed a blood pressure of 117/80 mmHg, a pulse rate of 67 beats/min, arrhythmic heart sounds, and clear lung fields on both sides. The electrocardiogram showed sinus rhythm with a heart rate of 63 bpm, along with persistent ST-segment elevation with pathological Q waves in V1–V4 (electrocardiographic features of left ventricular aneurysm) (Figure 1). The two-dimensional transthoracic echocardiography demonstrated the existence of an anteroapical left ventricular aneurysm, this adverse cardiac remodeling resulting in a severe impairment of the left ventricular systolic function and a moderate functional mitral regurgitation. The left ventricular ejection fraction assessed with the Simpson's biplane method was 30%, while the left ventricular global longitudinal strain value on speckle-tracking echocardiography was -9.9% (Figure 2). A grade 2 diastolic dysfunction (translating the existence of increased filling pressures) was identified with the help of tissue Doppler imaging.

Given the detection of multiple premature ventricular contractions throughout the echocardiographic evaluation, we opted for 24-hour Holter monitoring during the same hospital visit, which disclosed the presence of 121 episodes of nonsustained ventricular tachycardia. Therefore, a cardiac magnetic resonance (CMR) scan was performed for a more comprehensive characterization of the arrhythmic substrate, a better morphological assessment of the left ventricular aneurysm, and the evaluation of left ventricular myocardial viability.

The CMR imaging emphasized an enlarged left ventricle (182 ml/m^2) with a severely impaired systolic function (an ejection fraction of 25%) because of an old transmural myocardial infarction located in the left anterior descend-

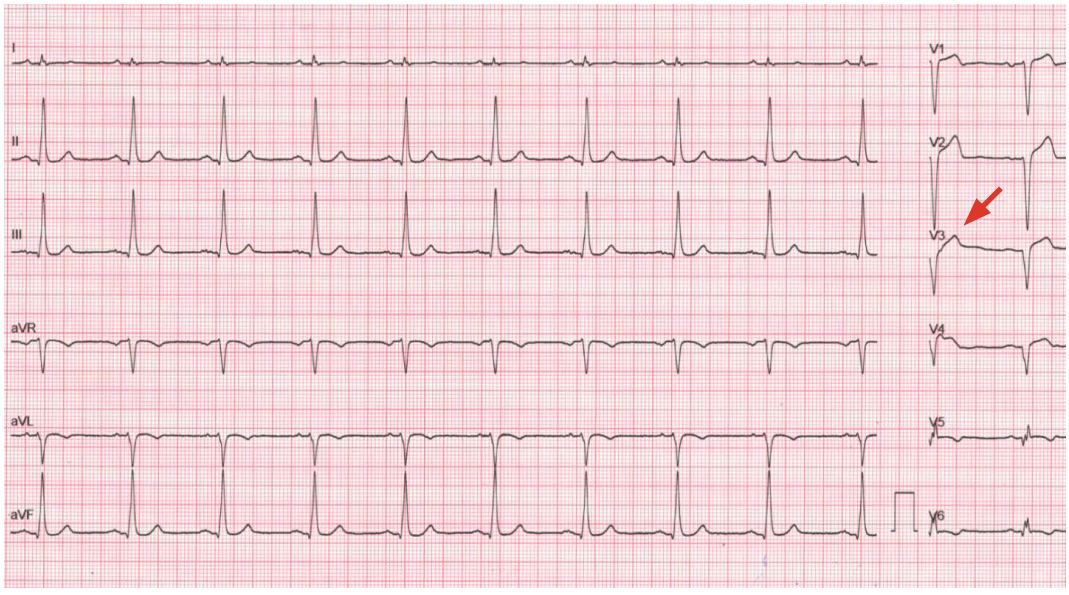

FIGURE 1. Admission ECG: electrocardiographic features of left ventricular aneurysm

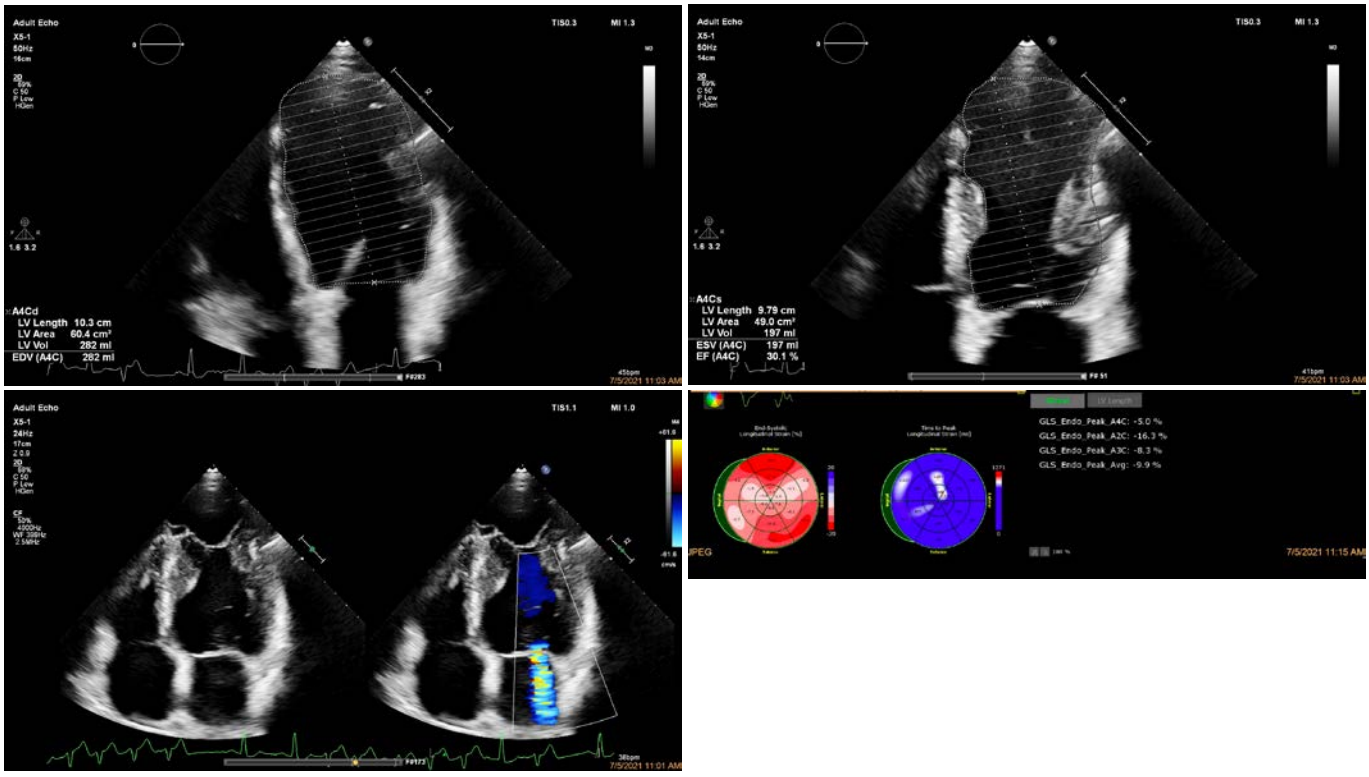

FIGURE 2. Transthoracic echocardiography: anteroapical left ventricular aneurysm, ischemic mitral regurgitation, assessment of left ventricular ejection fraction with Simpson's biplane method and of left ventricular global longitudinal strain with speckle-tracking echocardiography

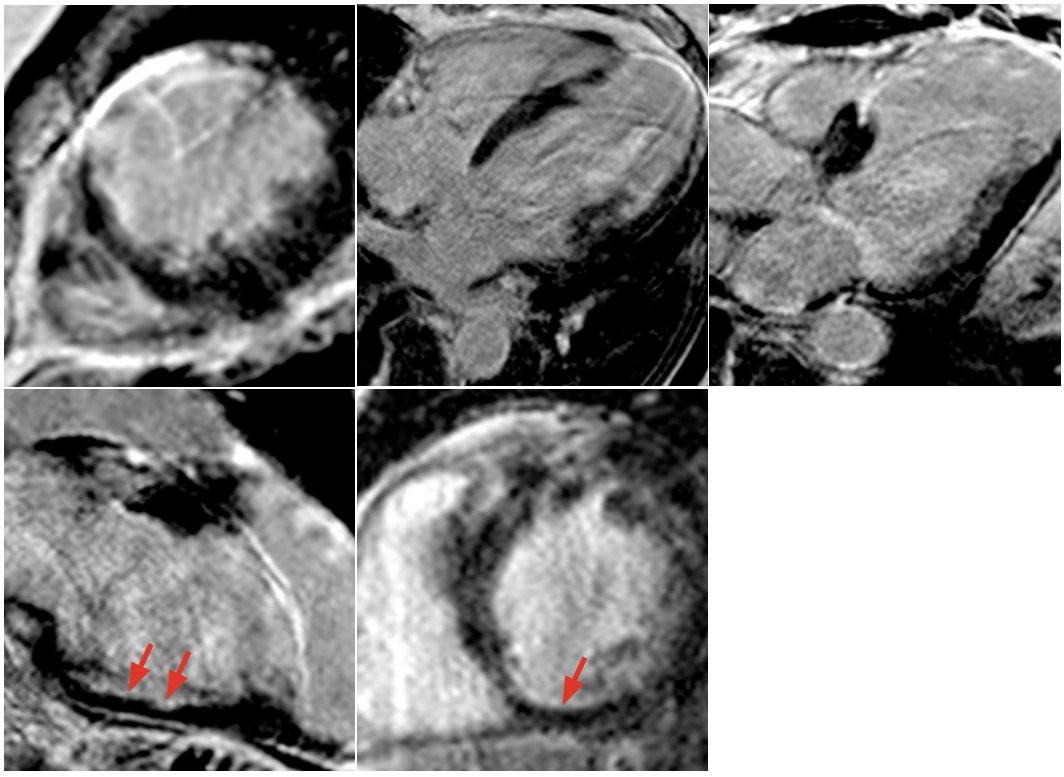

FIGURE 3. Late gadolinium enhancement on cardiac magnetic resonance imaging highlighting the existence of extensive myocardial fibrosis

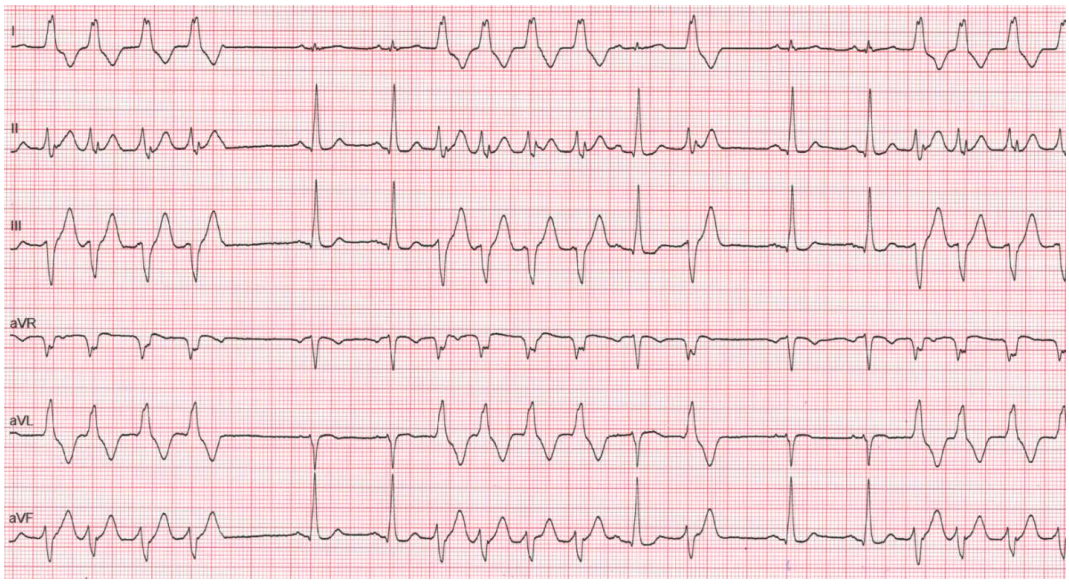

FIGURE 4. Repetitive nonsustained ventricular tachycardia on resting ECG

ing coronary artery territory (no significant residual myocardial viability in this infarcted area) and because of an old subendocardial myocardial infarction situated in the right coronary artery territory (with significant residual myocardial viability in this region) (Figure 3). No myocardial scars were found in the left circumflex artery territory, and no myocardial edema or intracavitary thrombosis was identified. The right ventricular ejection fraction on CMR was 52%.

Following the CMR scan, the patient was hospitalized for the therapeutic management of malignant ventricular arrhythmias and of heart failure with reduced ejection fraction, based on current guidelines. The resting electrocardiogram showed sinus rhythm with repetitive nonsustained ventricular tachycardia (Figure 4). Laboratory tests identified the existence of a mixed atherogenic dyslipidemia, with elevated levels of triglycerides (278 mg/dl) and low-density lipoprotein cholesterol (170 mg/dl).

Primarily, an electrophysiological study was performed, with the transcatheter ablation of the recurrent nonsustained ventricular tachycardia arising from the basal septum of the left ventricle, under the guidance of the CARTO three-dimensional mapping system. Throughout the electrophysiological study, there were no inducible sustained ventricular tachyarrhythmias.

Considering the previous diagnosis of two-vessel CTO with the identification of viable myocardium within the right coronary artery territory on CMR imaging, the pa-

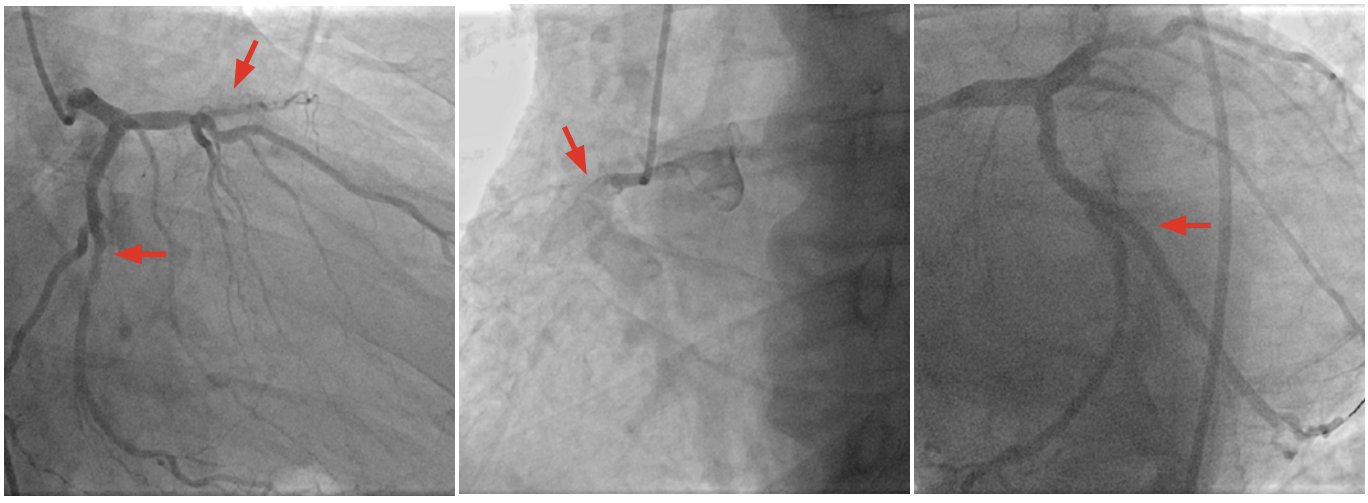

FIGURE 5. Coronary angiography images before and after percutaneous coronary intervention

tient's refusal for coronary artery bypass grafting, the relatively early onset of coronary artery disease, the persistence of an atherogenic lipoprotein profile despite long-term statin therapy, and the high arrhythmic burden, another coronary angiography was performed. Apart from the above-mentioned two CTOs, this time the coronary angiography has also identified serial stenoses of 85–90% at the level of the proximal obtuse marginal artery. Subsequently, a drug-eluting stent was implanted using the 'provisional' approach.

Unfortunately, the retrograde recanalization of the right coronary artery CTO was not technically possible because of insufficiently developed collaterals, while the anterograde approach has previously failed (Figure 5).

The follow-up Holter ECG monitoring revealed a marked decrease in the number of premature ventricular contractions following the radiofrequency ablation of the ventricular substrate and the percutaneous coronary intervention (only 17 in 24 hours). Nevertheless, the patient received an implantable cardioverter-defibrillator (ICD) for the primary prevention of sudden cardiac death (class I recommendation, level of evidence A) as indicated by the 2021 guidelines on acute and chronic heart failure. He was discharged with a conventional therapeutic regimen for heart failure with reduced ejection fraction, comprising a beta-blocker (carvedilol 6.25 mg daily) a mineralocorticoid receptor antagonist (spironolactone 25 mg daily), an angiotensin-converting enzyme inhibitor (ramipril 2.5 mg daily), and a sodium-glucose co-transporter 2 inhibitor (dapagliflozin 10 mg daily). The addition of a neprilysin inhibitor was temporized due to low blood pressure values.[3]

In addition, a standard dual antiplatelet therapy regimen (aspirin 100 mg daily and ticagrelor 90 mg twice daily) was prescribed for the prevention of coronary stent thrombosis. The daily dose of 3-hydroxy-3-methylglutaryl coenzyme-A reductase inhibitor was increased (from 10 mg to 80 mg atorvastatin) as a means of achieving an optimal LDL-cholesterol level (<55 mg/dl) as recommended by the current guidelines on dyslipidemia and cardiovascular disease prevention.[4,5]

DISCUSSION

This case emphasizes that the noninvasive assessment of myocardial fibrosis via multimodality cardiac imaging allows the implementation of an individualized therapeutic decision. Ventricular myocardial fibrosis represents a crucial arrhythmic substrate that can be accurately evaluated with the help of advanced echocardiographic techniques and CMR imaging.

CMR is a powerful, well-validated imaging tool for the evaluation of myocardial fibrosis and myocardial viability, as well as for the assessment of right and left ventricular volume and function.[6] In individuals with ischemic heart failure and a left ventricular ejection fraction ≤35%, the delivery of an ICD has to be considered for the primary prevention of sudden cardiac death.[1] In subjects with an ejection fraction ≥35%, the extent of late gadolinium enhancement on CMR imaging strongly predicts the risk of sudden cardiac death and the need for ICD therapy in primary prevention.[6] Valuable information about myocardial function and viability can be also acquired from speckle-tracking echocardiography-derived indices. Various studies have demonstrated that left ventricular global longitudinal strain on speckle-tracking echocardiography can be used as a surrogate marker for replacement fibrosis in patients with non-ischemic and ischemic cardiomyopathy.[7,8]

Additionally, in individuals with a high arrhythmia burden, the catheter ablation of ventricular arrhythmias should be used in conjunction with ICD therapy as a way of reducing ventricular arrhythmia recurrence and thus decreasing repetitive ICD therapy.[9]

Coronary CTO is defined as the presence of a complete blockage of a coronary artery with Thrombolysis in Myocardial Infarction (TIMI) 0 flow at coronary angiography, for more than 3 months. In patients with ischemic heart disease and CTO, it is extremely important to assess the presence and the extent of myocardial viability via different cardiac imaging techniques in order to predict a potential functional recovery following revascularization. Percutaneous coronary intervention is not always technically achievable in CTO (higher complication rate and lower success rate when compared to non-CTO), whereas coronary artery bypass surgery is reserved for subjects with left main artery disease or proximal left anterior descending artery disease that irrigates a viable anterior wall, and for subjects with three-vessel disease and insulin-dependent diabetes, severely impaired left ventricular systolic function, or chronic kidney disease.[10]

CONCLUSIONS

In patients with ischemic heart failure, repetitive ventricular tachycardia, and coronary CTO, the therapeutic decision should be personalized, taking into consideration the results of multimodality cardiac imaging and the opinion of a multidisciplinary 'Heart Team' (clinician, echocardiographist, radiologist, interventional cardiologist, and cardiac surgeon).

CONFLICT OF INTEREST

Nothing to declare.

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