

Cardiogenic shock due to arrhythmia-induced cardiomyopathy and its recovery after radiofrequency ablation under extracorporeal membrane oxygenation support



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Introduction

In recent years, the term *arrhythmia-induced cardiomyopathy* (AiCM) has emerged as a common cause of left ventricular systolic dysfunction. A persistent increase in ventricular rate regardless of tachycardia's origin is associated with left ventricular systolic dysfunction, which may be reversible if the primary source of the tachycardia is treated. One cause of AiCM is the incessant form of focal atrial tachycardia.¹

We describe the case of a 32-year-old female patient who arrived at our hospital with cardiogenic shock secondary to incessant atrial focal tachycardia and her recovery after treatment with radiofrequency ablation (RFA) under extracorporeal membrane oxygenation support.

Case presentation

A 32-year-old woman with a medical history of nonspecific tachyarrhythmia arrived at the emergency department with 2 weeks of progressive shortness of breath. During the physical examination in the emergency department, her heart rate was regular at 180 beats/min with a blood pressure of 90/55 mm Hg and markedly reduced peripheral perfusion. Cardiac auscultation revealed normal S1 and S2 without gallops or murmurs, and there were bilateral rales at pulmonary examination. High doses of inotropes, vasopressors, and diuretics were initiated. The admission electrocardiogram showed a regular narrow complex tachycardia with a heart rate of 190 beats/min with P-wave polarity positive in lead V₁ and inferior leads and isobiphasic in lead aVL, suggesting an ectopic atrial origin of the tachycardia. She received

WHAT WE LEARNED FROM THIS CASE:

- Incessant atrial tachycardia can present with profound cardiomyopathy and cardiogenic shock, the most extreme presentation of arrhythmia-induced cardiomyopathy.
- Arrhythmia-induced cardiomyopathy is reversible after the restoration of sinus rhythm and normal heart rate. An invasive strategy should be considered if the arrhythmia is medically refractory.
- The use of left ventricular assistance support devices should be considered when needed to permit treatment of the arrhythmia.

adenosine 6 mg intravenously 3 times, developing transient atrioventricular block followed by persistence of atrial activity. Subsequently, electric cardioversion was performed 3 times under continuous amiodarone infusion without terminating the tachyarrhythmia.

A transthoracic echocardiogram showed a severely dilated left ventricle with diffuse hypokinesia, severe systolic ventricular dysfunction (left ventricular ejection fraction [LVEF] 20%), severe functional mitral regurgitation, and a nondilated right ventricle with preserved systolic function.

Despite inotropic and antiarrhythmic support, the patient continued hemodynamically unstable and with persistence of the arrhythmia. For this reason, she was connected to extracorporeal circulatory membrane oxygenation (ECMO) support to perform an electrophysiology study of the arrhythmia and eventually treat the arrhythmic source with RFA.

The quadripolar and decapolar catheters were placed on the His bundle and right atrium, where we did not find the earliest activation signal. Therefore, we performed a transseptal puncture inserting Lasso and ThermoCool

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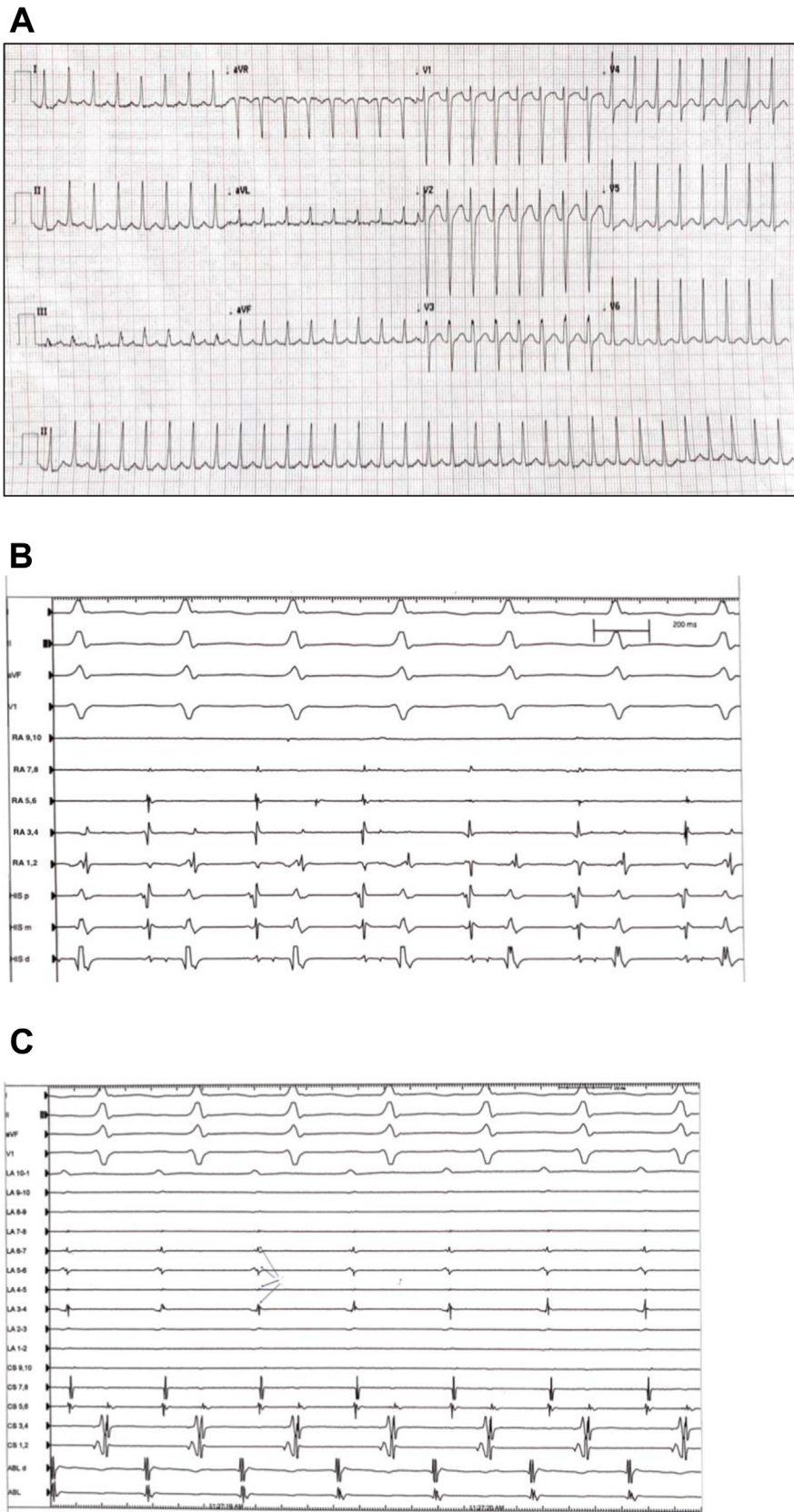


Figure 1 A: Twelve-lead electrocardiogram showing a regular narrow complex supraventricular tachycardia suggests a focal ectopic origin of the P wave. **B–D**: Identification of an ectopic focus triggering on the zone between the left atrial appendage and the left superior pulmonary vein. The period between the first signal on the ablation catheter (ABL-d) and the onset of the P wave is 44 ms, suggesting the focal ectopic origin of the tachycardia. **E and F**: The end of the ectopic focal atrial tachycardia after applying a pulse of radiofrequency and the return to sinus rhythm. **G**: Electroanatomic mapping of the ectopic focus and its relationship with the electrical signals.

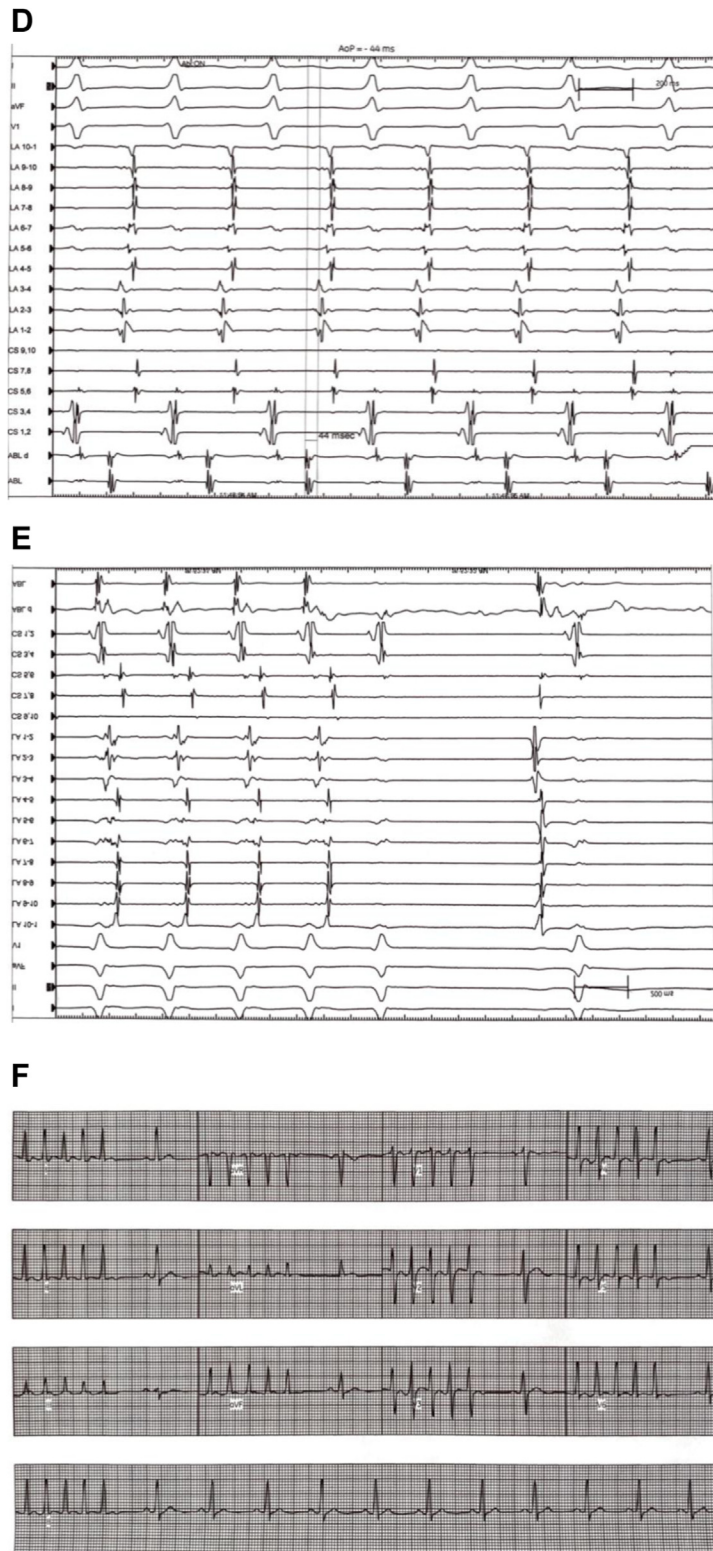


Figure 1 Continued

SmartTouch catheters (Biosense Webster, Irvine, CA) to perform an electroanatomic mapping of the left atrium. We found the earliest activation signal (45 ms before the onset of the P wave) in the zone between the edge of the left atrial

appendage and the left superior pulmonary vein. A successful RFA pulse was applied to this zone of interest, achieving the end of the tachycardia and returning to an activation sequence in sinus rhythm (Figure 1).



Figure 1 Continued

The patient returned to the coronary care unit and was weaned from circulatory and ventilatory support 3 days later without problems. After 3 weeks of medical treatment and cardiovascular rehabilitation, the patient was discharged without dyspnea and congestive signs. At 3-month follow-up, she presented no clinical evidence of symptomatic relapse and no recurrence of the arrhythmia in 24-hour rhythm monitoring. In addition, the control transthoracic echocardiogram showed almost complete recovery of LVEF (55%).

Discussion

Since the publication of Whipple et al,² we have known that continuous rapid atrial stimulation could drive ventricular dysfunction and ventricular dilatation without hypertrophy.³

We report a clinical case of a young woman presenting to the hospital with refractory cardiogenic shock presumably secondary to severe cardiomyopathy by an incessant focal atrial tachycardia. The recovery of LVEF after arrhythmia ablation confirmed our diagnosis.

The latest guidelines for managing patients with supraventricular tachycardia recommend RFA as the definitive treatment of focal atrial tachycardia. The success rate of RFA in focal atrial tachycardia is ~85% with few complication rates (<1%).⁴

Few medical literature reports describe the occurrence of supraventricular arrhythmias that lead to cardiogenic shock

with successful results when treating these patients with RFA under ECMO as ventricular support.^{5,6}

There is no recommendation about the optimal LV assistance device in cardiogenic shock due to AiCM in international guidelines.⁷ However, in our local medical environment, we have more availability and experience treating these patients with ECMO as a biventricular assistance device as we do with other nondifferentiated severe cardiogenic shocks.

This case demonstrates that AiCM, even when presenting as shock, is a reversible cardiomyopathy. Mechanical support with ECMO permitted definitive treatment with RFA.

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