



Radiofrequency ablation as a treatment for tachycardiomyopathy induced by premature ventricular contractions in the tricuspid annulus

Ablación con radiofrecuencia como tratamiento para taquicardiomiopatía inducida por complejos ventriculares prematuros originados en el anillo tricuspídeo

Heberto Aquino Bruno,* Yeiscimin Sánchez Escobedo,*
Mariana Lourdes Añas Méndez,* Karla Ivette Bozada Nolasco,* Carlos De la Fuente Macip,*
Arturo Enríquez Silverio,* Ulises Rojel Martínez†

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* Electrophysiology and Cardiac Stimulation Laboratory.

† President of SOMEEC. Chief of Electrophysiology and Cardiac Stimulation Laboratory.

Puebla General Hospital «Dr. Eduardo Vázquez Navarro», Health Services of the State of Puebla, Mexico.

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ABSTRACT

Introduction: Most ventricular arrhythmias are related to structural heart disease. When they occur in anatomically normal hearts are known as idiopathic arrhythmias. The highest percentage of premature ventricular complexes (PVC) is originated in the right ventricular outflow tract. However, less frequent sites have been described, such as the tricuspid annulus. Irregular rhythm along with a high percentage of arrhythmic burden (AB) have an important role in the deterioration of left ventricular function. **Objective:** To describe the return to normal ventricular function after PVC radiofrequency ablation (RFA). **Case study:** A 75-year-old man, without relevant history, presented with mild exertion dyspnea and frequent palpitations. The physical examination was normal, the 12-lead electrocardiogram showed premature ventricular contractions with a left bundle branch block (LBBB) pattern and superior axis. A Holter monitoring documented a 35% arrhythmic burden and transthoracic echocardiography demonstrated an LVEF of 40% and global hypokinesia, without valvular heart disease. An electrophysiological study was conducted with three-dimensional mapping that observed the origin of the PVC at the septal tricuspid annulus. RFA was performed in this area, resulting in the immediate disappearance of PVC. **Results:** At 3 months a 24-hour Holter monitoring showed 0.02% of AB and a transthoracic echocardiogram showed LVEF of 65%. **Conclusion:** Premature ventricular contractions originating from the tricuspid annulus are an uncommon cause of tachycardiomyopathy and RFA treatment is safe and effective.

RESUMEN

Introducción: La mayoría de las arritmias ventriculares están relacionadas con patología estructural del corazón; cuando ocurren en corazones anatómicamente normales se consideran arritmias idiopáticas. El mayor porcentaje de los complejos ventriculares prematuros (CVP) se atribuyen al tracto de salida del ventrículo derecho; sin embargo, se han identificado sitios menos frecuentes como el anillo tricuspídeo. La asincronía y el ritmo irregular junto con un alto porcentaje de la carga arritmica (CA) tienen un rol importante en el deterioro de la función ventricular izquierda. **Objetivo:** Describir la normalización de la función ventricular posterior a ablación con radiofrecuencia de los CVP. **Caso clínico:** Hombre de 75 años de edad, sin antecedentes de importancia; acudió por presentar disnea de medianos esfuerzos y palpitaciones frecuentes. La exploración física fue normal, el electrocardiograma de 12 derivaciones mostró CVP con patrón de bloqueo de rama izquierda; un monitoreo Holter documentó 35% de carga arritmica, un ecocardiograma transtorácico reportó FEVI de 40% e hipocinesia generalizada, sin valvulopatías. Se decidió realizar estudio electrofisiológico con mapeo tridimensional, donde se observó el origen de las CVP a nivel del septal del anillo tricuspídeo, se procedió a ablación con radiofrecuencia en dicha zona, lo que mostró desaparición inmediata de las extrasístoles. **Resultados:** A los tres meses, un monitoreo Holter de 24 h reportó sin evidencia de arritmias ventriculares y un ecocardiograma transtorácico demostró FEVI de 65%. **Conclusión:** Los complejos ventriculares prematuros del anillo tricuspídeo son una causa rara de cardiomiopatía, el tratamiento mediante ablación con radiofrecuencia es una terapia eficaz y segura.

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Abbreviations:

- PVC = Premature ventricular complexes.
- AB = Arrhythmic burden.
- LVEF = Left ventricular ejection fraction.
- IVA = Idiopathic ventricular arrhythmias.
- TA = Tricuspid annulus.
- AiTCM = Arrhythmia-induced tachycardiomyopathy.
- LVD = Left ventricular dysfunction.
- VE = Ventricular extrasistoles.
- RFA = Radiofrequency ablation.
- LBBB = Left bundle branch block.

Abreviaturas:

- CVP = Complejos ventriculares prematuros.
- CA = Carga arritmica.
- FEVI = Fracción de expulsión de ventrículo izquierdo.

INTRODUCTION

Most ventricular arrhythmias are associated with structural heart disease, primarily of ischemic etiology. However, a small subset occurs in patients with anatomically healthy hearts and are known as idiopathic arrhythmias.¹

Although idiopathic ventricular tachycardias (IVT) were previously considered benign and non-life-threatening, there is currently evidence that frequent premature ventricular complexes (PVC) are associated with a substantial increase in the risk of sudden cardiac death.² Also, it has been reported that between 9% and 34% of patients with IVT develop tachycardiomyopathy.^{3,4} The majority of PVC originate in the right ventricle outflow tract,^{5,6} however, others such as the tricuspid annulus (TA) have been identified as less frequent sites, accounting for between 8-9% of cases.⁶⁻⁸

Arrhythmia-induced tachycardiomyopathy (AiTCM) is defined as a reduced left ventricular ejection fraction (LVEF) \leq 50% in the absence of any underlying heart disease, with an improvement in LVEF of \geq 15% after effective ventricular arrhythmia treatment.⁹

Radiofrequency ablation (RFA) treatment is advised when an idiopathic ventricular arrhythmia occurs together with left ventricular dysfunction (LVD).¹⁰⁻¹²

The following case shows a patient that presented symptomatic PVC's originating in the TA who underwent RFA.

CASE PRESENTATION

A 75-year-old man, without relevant history, presented with mild exertion dyspnea and palpitations. The physical examination was normal, the 12-lead electrocardiogram showed premature ventricular contractions with a left bundle branch block pattern, normal axis, QS in V1, transition zone between V2-V3, R in D1 and aVL, QS in aVR, which suggested an origin in the tricuspid annulus (Figure 1). A Holter monitoring, documented a 35% arrhythmic burden and transthoracic echocardiography demonstrated an LVEF of 40%, global hypokinesia, and diastolic dysfunction type I without structural heart disease. An electrophysiological study was performed using EnSite Precision

Abbott® three-dimensional mapping software (Figure 2). The study showed fragmented and low amplitude electrograms (100 ms duration and $<$ 1 mV) and the precocity index of the ventricular electrogram (-28 ms) in the septal region of the tricuspid annulus (Figure 3). An irrigated FlexAbility™ Abbott® catheter was used to RFA of 30 W with a temperature limit of 25 °C. The PVC's disappeared during the administration of RFA (Figure 4). Programmed ventricular stimulation was performed, with and without dobutamine infusion, without inducing contractions, neither other ventricular arrhythmias.

Fluoroscopy time was 26 minutes and there were no complications during the procedure. At 3 months, a 24-hour Holter monitoring was performed without evidence of ventricular arrhythmias. The AB was reduced from 35% to 0.02% with otherwise morphology from PVC's

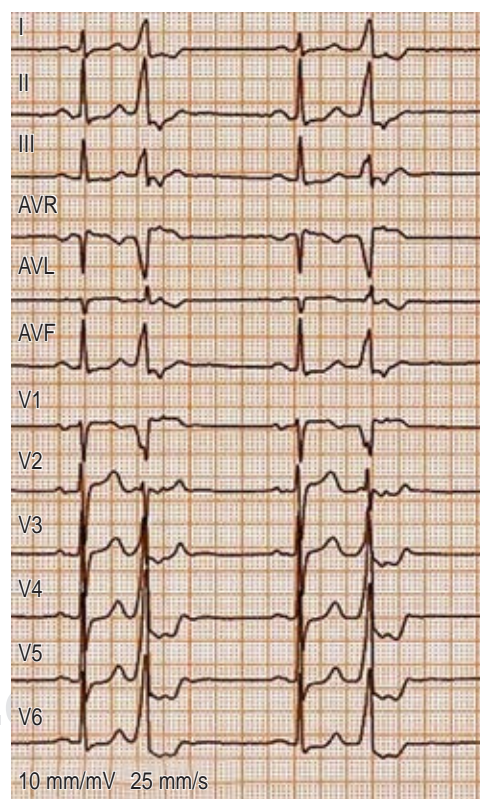


Figure 1: Contractions with a left bundle branch block pattern, normal axis, QRS duration 120 ms transition zone between V2-V3 and QS in V1 (TA septal region), R in DI and aVL, QS in aVR.

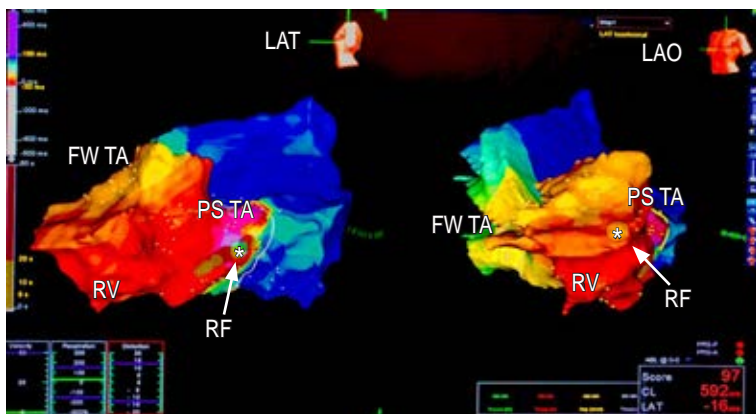


Figure 2: Three-dimensional map made with the EnSite system[®], localization of the tricuspid annulus with contractions originating at the posteroseptal level (*). The red color represents the origin of the arrhythmia, the degradation towards blue and violet, are the regions where it is depolarized a later way. LAO = left anterior oblique projection; LAT = lateral projection; PS TA = posteroseptal TA; FW TA = free wall TA; RV = right ventricle; RF = radiofrequency; RV = right ventricle; RF = radiofrequency target foci.

treated and a transthoracic echocardiogram reported LVEF of 65% without mobility impairments. The ectopic focus was eliminated with the recovery of ventricular systolic function.

DISCUSSION

Seventy to eighty percent of PVC originate in the right ventricle outflow tract.^{5,6} Less frequent origin sites such as the TA have been identified and accounting for between 8-9% of cases.

There is low evidence of PVCs originating from the TA due to their low incidence. To locate the site of origin of the arrhythmia, an appropriate electrocardiographic analysis must be performed. There are two studies of patients with PVC originating in the TA.^{7,8} Both coincide with the electrocardiographic characteristics of the PVC of this region, with LBBB patterns that have transition zones in V2-V3 and positive polarity in V6 and DI. There are two previously cases reporting of TA PVCs that were associated with tachycardiomyopathy.^{13,14}

The association of fast and irregular ventricular rhythms with higher AB has been established as the main cause of tachycardiomyopathy.^{11,12,15,16} There is evidence that an AB greater than 10% may result in LVD,^{8,16-18}

however, PVC burden greater than 24% appears to be independently associated with a decreased ejection fraction.¹⁹ In such cases either pharmacological treatment or catheter ablation is necessary.

There are 2 types of AiTCM: type 1, in which arrhythmia is the only cause of tachycardiomyopathy, and left ventricular function returns to normal after successful treatment; type 2 refers to arrhythmic event exacerbates underlying damage, and its treatment results in partial resolution of the tachycardiomyopathy.^{11,16}

The treatment with RFA is recommended and has demonstrated high success rates when arrhythmias are associated with ventricular dysfunction or situations with AB > 10%.¹⁵ Regarding anatomy, treatment has been observed as more effective in patients with structurally healthy hearts and origin in the right ventricle,^{8-11,20} with a success rate between 80% and 90%.

AiTCM patients are often highly symptomatic with a significantly reduced quality of life, hence the importance of timely diagnosis and treatment given the reversibility of ventricular dysfunction.

According to the 2019 expert consensus statement of ventricular arrhythmias,²¹ catheter ablation is recommended in patients with cardiomyopathy caused by PVC predominantly monomorphic, frequent, and for whom antiarrhythmic drugs are ineffective, not tolerated, or not preferred for long-term therapy (class I).

Different reports have shown that, after undergoing ablation treatment, patients with

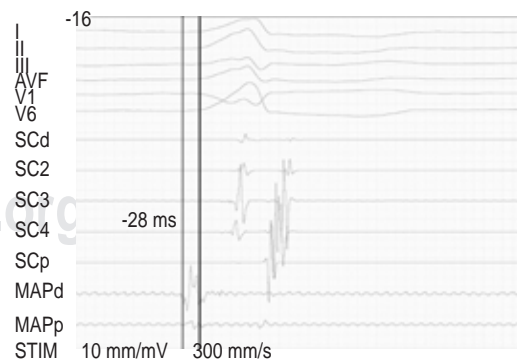


Figure 3: Intracavitary electrograms with maximum precocity of -28 ms.

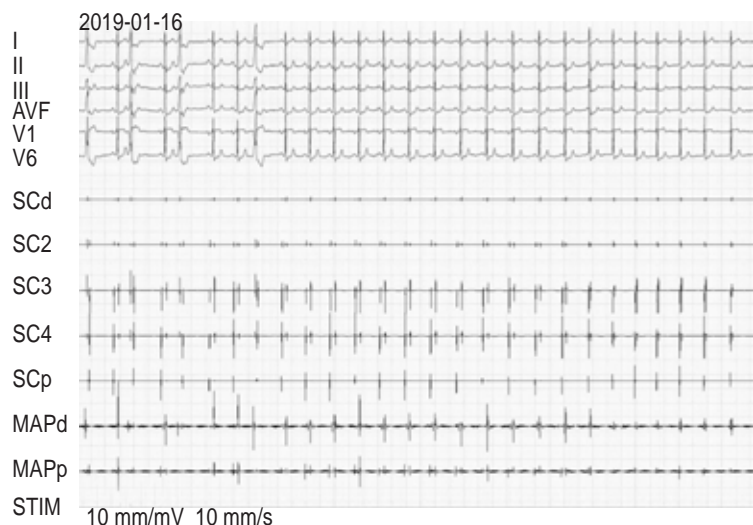


Figure 4: Disappearance of contractions after the application of radiofrequency of 30 W with a temperature limit of 25 °C.

tachycardiomyopathy experience ejection fraction recovery within the first 12 weeks, so it is recommended to perform an echocardiogram and Holter monitor control 3 months after ablation.²¹⁻²³

The patient described in this report had an initial AB of 35% and an echocardiogram reported an LVEF of 40% without evidence of ischemia or structural alteration. After undergoing RFA, follow-up tests were performed at 3 months demonstrating a decrease in arrhythmic burden (0.02%) and the LVEF increased to 65%, thus complying with the criteria of AiTCM type 1.

CONCLUSIONS

Premature ventricular contractions originating from the tricuspid annulus are an uncommon cause of type 1 cardiomyopathy. High arrhythmic burden is the main determinant for ventricular dysfunction. Radiofrequency ablation is safe, effective, and indicated for patients in whom antiarrhythmic drugs are ineffective, not tolerated, or not preferred for long-term therapy.

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Correspondence to:

Dr. Heberto Aquino Bruno

Electrophysiology and Cardiac Stimulation Laboratory,
Puebla General Hospital «Dr Eduardo Vázquez Navarro»,
Health Services of the State of Puebla,
Mexico.

Antiguo Camino Guadalupe Hidalgo 11350,
Guadalupe Hidalgo, 72490,
Puebla, Puebla, Mexico.

Tel: +52 222 112 35 29

E-mail: ha_bruno11@hotmail.com