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CASE REPORT

ADVANCED

CLINICAL CASE

Refractory Ventricular Tachycardia Originating From an Intracardiac Metastasis Treated With Catheter Ablation

Pablo Salazar, MD,[a] Andrew Chen, MD,[a] Aalap Narichania, MD,[a] Ryan Burris, MD,[a] Swati Rao, MD,[a] Urooba Nadeem, MD,[b] Roderick Tung, MD[a]

ABSTRACT

A 45-year-old man with stage IV melanoma presented with incessant nonsustained wide complex tachycardia. He was found to have a right ventricular intracardiac metastasis that created a nidus for ventricular tachycardia refractory to multiple therapeutic interventions. The patient underwent catheter ablation for this rare indication, with successful arrhythmia control by direct ablation over the tumor surface. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:1231–5) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

INTRODUCTION

Arrhythmias are rare manifestations of cardiac tumors, and their management represents a challenge because of the limited treatment options, atypical arrhythmia mechanisms, and poor prognoses. We report a case of multidrug-refractory ventricular tachycardia (VT) that originated from endomyocardial biopsy-proven metastatic melanoma with sarcomatous transformation and that was successfully treated with catheter ablation.

LEARNING OBJECTIVES

- To recognize VT as a manifestation of underlying cardiac tumors.
- Identify treatment options available for cardiac arrhythmias associated with cardiac tumors.

HISTORY OF PRESENTATION

A 45-year-old man with a history of metastatic melanoma presented to the emergency department with fatigue and palpitations. He was normotensive and had a heart rate of 176 beats/min. The electrocardiogram (ECG) demonstrated pleomorphic VT with a predominant left bundle branch configuration, superior axis, and late precordial transition in lead V_6, findings suggesting an exit site in the moderator band region (**Figures 1A and 1B**).

PAST MEDICAL HISTORY

He had a history of metastatic melanoma with sarcomatous features and unknown primary source for which he had undergone multiple chemotherapy and immunotherapy regimens. The melanoma was rendered quiescent in 2018 but recurred in 2019. A

From the [a]Department of Cardiology, Center for Arrhythmia Care, Pritzker School of Medicine, University of Chicago, Chicago, Illinois, USA; and the [b]Department of Pathology, Pritzker School of Medicine, University of Chicago, Chicago, Illinois, USA.
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ABBREVIATIONS AND ACRONYMS

ECG = electrocardiogram

ICD = implantable cardioverter-defibrillator

ICE = intracardiac echocardiography

PMVT = polymorphic ventricular tachycardia

RF = radiofrequency

VT = ventricular tachycardia

positron emission tomography scan showed disseminated disease, including hypermetabolic cardiac lesions with a highly avid focus on the free wall of the right ventricle as well as the basal septum (**Figures 2A to 2C**).

DIFFERENTIAL DIAGNOSES

The differential diagnoses of wide complex tachycardia include the following: VT, most likely in the presence of structural heart disease; supraventricular tachycardia with aberrancy, and for this a review of previous ECGs is helpful to establish the presence of an underlying conduction disease; and supraventricular tachycardia with pre-excitation, in which the absence of a short PR interval along with a delta wave in the baseline ECG excludes overt pre-excitation through an antegrade accessory pathway, although atriofascicular connections (Mahaim) may be decremental and inapparent during baseline rhythm; these accessory pathways insert into the right bundle and may give rise to typical left bundle branch block patterns.

INVESTIGATIONS

The results of complete blood laboratory testing were unremarkable. Irregular ventricular rhythms with variable cycle lengths between 266 and 485 ms were observed, with multiple minor changes in QRS complex configurations (pleomorphism) in the presence of overt atrioventricular dissociation. The echocardiogram showed an ejection fraction of 38%.

MANAGEMENT

A sequential combination and trial of beta-blockers, lidocaine, mexiletine, quinidine, amiodarone, procainamide, and sotalol were implemented without any significant arrhythmia suppression. A percutaneous left-sided stellate ganglion block with bupivacaine (10 ml; 0.5%) was performed, but it failed to terminate or control the arrhythmia burden. At this point, a decision was made to pursue catheter ablation as a last resource strategy. The patient provided informed consent, as well as consent to the University of Chicago Prospective Ablation Registry, approved by the Institutional Review Board.

The procedure was performed with the patient under general anesthesia. Intracardiac echocardiography (ICE) showed a hyperechogenic mass in the inferior-basal right ventricle that extended from the free wall toward the septum and encased the moderator band (**Figures 2A to 2C**). By using endomyocardial biopsy forceps, a total of 6 endocardial samples were obtained from the tumor surface for histopathologic analysis.

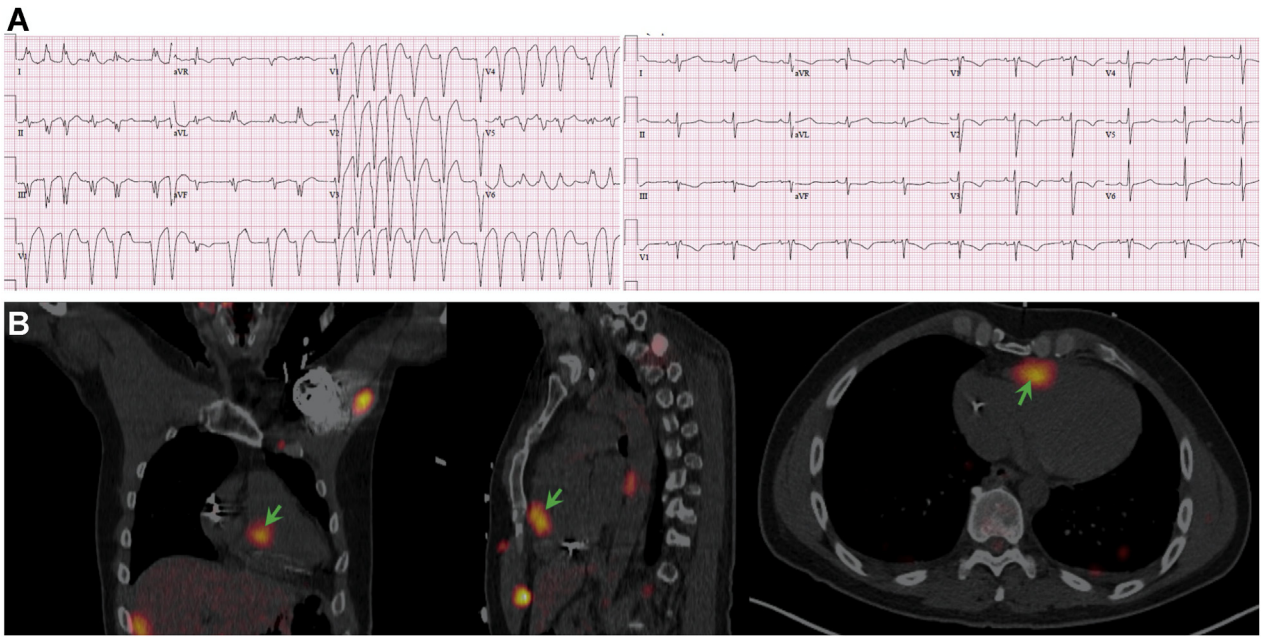
A high-density endocardial electroanatomic map was created using EnSite Precision (Abbott, Abbott Park, Illinois). An endocardial voltage map demonstrated minimal patchy bipolar low-voltage areas (0.5 to 1.5 mV) in the right ventricular basal inferior and free walls. Intracardiac electrograms showed fractionated potentials around the moderator band region and the tumor surface. The activation map was consistent with an exit site in the region of the moderator band (**Figure 3A,** Video 1). Under direct ICE visualization, radiofrequency (RF) ablation was applied to target the earliest area of pre-systolic activation (−39 ms directly on the tumor surface) with an irrigated catheter (FlexAbility, Abbott) (**Figure 3B**). The first RF lesion terminated the incessant salvos of polymorphic VT (PMVT) within 5 s (**Figure 3C**). Next, multiple RF lesions were delivered along the tumor surface and surrounding the moderator band. The arrhythmia remained suppressed and was rendered noninducible after triple-extrastimulus testing.

The patient remained free of PMVT during the next 48 h of observation and was subsequently discharged home without antiarrhythmic agents. Twenty days later, the patient had a recurrence, but this time with symptomatic high-burden premature ventricular contractions without VT. Repeat ablation was performed from the right ventricular outflow tract near the septal tumor insertion, which was superior and septal to the previous successful ablation site. This procedure resulted in palliative symptom relief and bridged him to allow additional experimental chemotherapy. The tumor biopsy results were consistent with melanoma metastasis, positive for S100 (**Figures 4A to 4C**).

DISCUSSION

VTs have been reported to be related to tumors arising from both ventricles, and usually excision of the tumor is the first line of treatment (1). Melanoma is the most common tumor that metastasizes to the heart. Sharma et al. (2) described a metastatic melanoma-associated PMVT that was successfully treated with antiarrhythmic agents and defibrillator implant. Only 2 reports of catheter ablation for intracardiac tumor associated with monomorphic VT have been described, where the earliest activation

FIGURE 1 Electrocardiogram and Fluorodeoxyglucose-Positron Emission Tomography Imaging

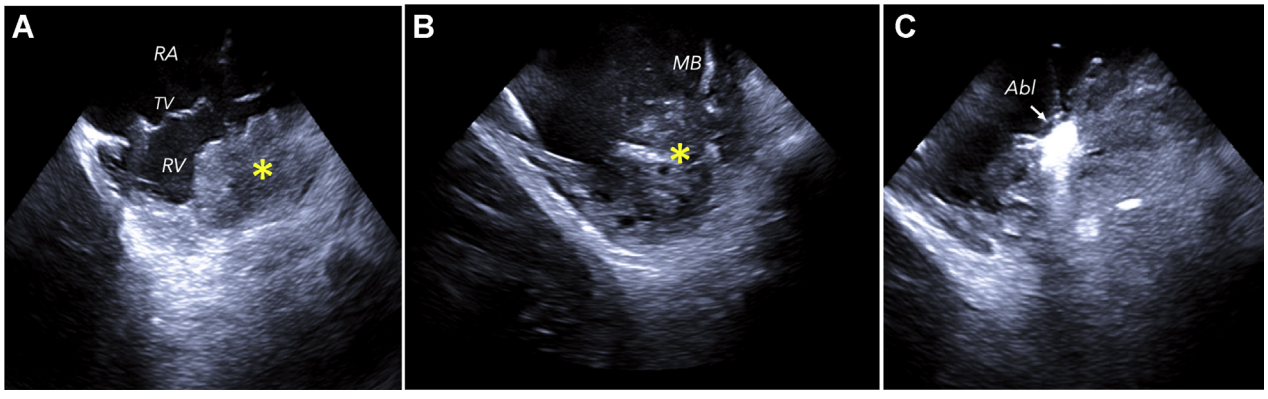


(A) Electrocardiogram of pleomorphic ventricular tachycardia salvos and baseline rhythm. **(B)** Fluorodeoxyglucose positron emission tomography. Coronal, sagittal, and axial views demonstrating multiple hypermetabolic lesions in liver, axillary ganglion, periaortic and right ventricular free wall **(green arrows)**.

was localized on the tumor surface and RF successfully terminated the arrhythmia (3,4).

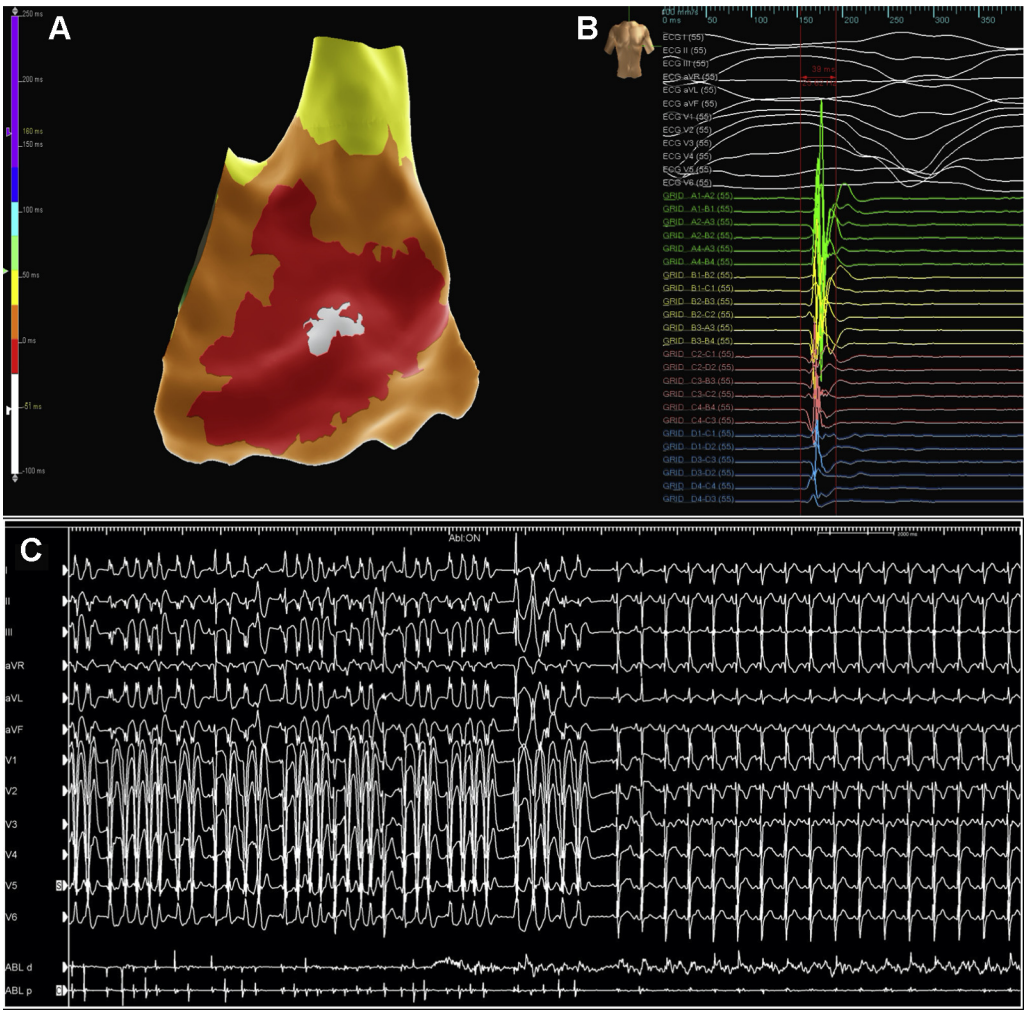
The treatments options for these arrhythmias have been limited to the use of antiarrhythmic agents and tumor surgical excision (5). The use of an implantable cardioverter-defibrillator (ICD) has been reported in patients with benign tumors, but its routine use in the setting of malignancy is questionable because the life expectancy is often <1 year (6). Given the patient's previous response to chemotherapy, his young age,

FIGURE 2 Views of Right Ventricular Tumor With Intracardiac Echocardiography



(A) Heterogenous and echogenic tumor on the endocardial surface **(asterisk). (B)** Anatomic relationship of the tumor encasing the moderator band (MB). **(C)** Radiofrequency lesion applied on the tumor surface at the successful termination site with increased echogenicity during ablation (Abl). RA = right atrium; RV = right ventricle; TV = tricuspid valve.

FIGURE 3 Activation Map and RF Ablation



(A) Activation map with a focal breakout pattern originating from the right ventricular free wall tumor location. **(B)** Early signal −39 ms before QRS complex onset recorded on the tumor surface. **(C)** Rapid termination of ventricular tachycardia in 5 s during radiofrequency (RF) application.

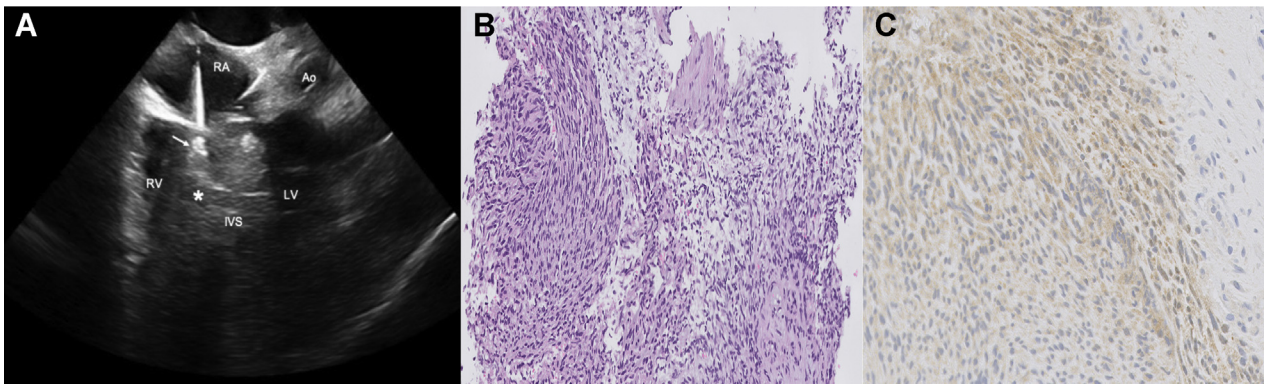
and his life expectancy of more than 2 years, ICD insertion was reasonable. Hence, RF ablation appears to be a feasible palliative alternative for medically refractory or inoperable cardiac tumor-associated arrhythmias. The theoretical risk of embolization of myocardial or tumor tissue, although present, was mitigated by continuous ICE surveillance after biopsy before ablation.

The mechanism by which cardiac tumors modulate the development of arrhythmias remains unclear. By extrapolating mechanisms from other cardiomyopathies, we could hypothesize that the tumor itself, along with its infiltration in the tissue, disrupts the normal electrophysiological properties of the surrounding myocardium and creates anatomic barriers to conduction that favor the development of re-entry, in a manner similar to that of scar tissue (7). The same electrophysiological disturbances may favor the development of multiple circuits, spiral wave re-entry, triggered activity, or mechanically induced automaticity that could explain a pleomorphic configuration.

FOLLOW-UP

After 12 months of follow-up, the patient remained free of VT and was not taking antiarrhythmic agents.

FIGURE 4 **ICE and Histopathologic Images**



(A) Intracardiac echocardiography (ICE) images during biopsy; the tumor **(asterisk)** and biopsy forceps **(arrow)** are visible. **(B)** Spindle cell tumor (original magnification ×100). **(C)** Tumor focally positive for S100. Ao = aorta; IVS = interventricular septum; LV = left ventricle; RA = right atrium; RV = right ventricle.

CONCLUSIONS

We report a rare case of endocardial biopsy-proven metastatic melanoma inducing incessant salvos of VT refractory to multiple antiarrhythmic drugs that was successfully treated with catheter ablation. Ablation has been rarely reported in these settings and can result in successful arrhythmia suppression in selected cases when all other therapies fail.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr. Roderick Tung, Center for Arrhythmia Care, University of Chicago Medicine, 5841 South Maryland Avenue, MC 6080, Chicago, Illinois 60637, USA. E-mail: roderickTung@uchicago.edu.

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KEY WORDS cancer, catheter ablation, ventricular tachycardia

APPENDIX For a supplemental video, please see the online version of this paper.