Delayed Purkinje potential during sinus rhythm in cardiac sarcoidosis with multiple focal Purkinje ventricular tachycardias: Ablation target or bystander?

Yasuhiro Shirai, MD, PhD, Masahiko Goya, MD, PhD, Susumu Tao, MD, PhD, Masateru Takigawa, MD, PhD, Tetsuo Sasano, MD, PhD

From the Department of Cardiovascular Medicine, Tokyo Medical and Dental University, Tokyo, Japan.

Introduction

The mechanism of ventricular tachycardia (VT) associated with structural heart disease is commonly scar-related myocardial reentry.[1] Purkinje-related VTs such as bundle branch reentrant tachycardia, interfascicular reentrant tachycardia, and focal Purkinje VT are less common but important entities of VTs with underlying heart disease.[2] When a diagnosis of focal Purkinje-VT is made, the Purkinje potential that precedes QRS onset during VT should also be recorded before QRS during sinus rhythm.[3] We report on a case with cardiac sarcoidosis with multiple focal Purkinje VTs in which the timing of the Purkinje potential was variable during sinus rhythm owing to underlying conduction disturbance.

KEY TEACHING POINTS

- Purkinje-related ventricular tachycardias (VTs) are less common compared with scar-related myocardial reentrant VTs, but are an important entity of VTs with underlying heart disease.
- Although the Purkinje potential that precedes QRS onset during focal Purkinje VTs should also be recorded before QRS during sinus rhythm, the timing can be variable depending on the baseline conduction disturbance.
- Mapping of the earliest Purkinje potential during VT is crucial to identify the optimal ablation site for focal Purkinje VTs.

Case report

A 45-year-old male patient with definitive diagnosis of cardiac sarcoidosis was referred to our institution for catheter ablation of VT storm that required frequent implantable cardioverter-defibrillator (ICD) therapy despite being on steroids. The patient was originally transferred to the outside hospital owing to sustained VT 3 years before he was referred to our institution. At that time, he also exhibited transient complete atrioventricular block and a cardiac resynchronization therapy defibrillator was implanted. Gallium scintigraphy and endomyocardial biopsy were positive for cardiac sarcoidosis and the patient was started on steroids.

A total of 3 VTs were recorded in the electrophysiology lab, 2 of which were eliminated by catheter ablation guided by pace mapping and entrainment mapping findings. The remaining VT with left bundle branch block configuration and superior axis (Figure 1), which exhibited narrow QRS (narrower than QRS during sinus rhythm, which showed right bundle branch block and left anterior hemiblock), was most frequently observed before the procedure, resulting in multiple ICD therapy. This VT was not inducible by programmed stimulation and was observed with nonsustained form, which was consistent with nonreentrant mechanism rather than reentry. High-frequency potential was recorded along the right ventricular septum after or within the QRS during sinus rhythm (Figure 1) and once this potential was selectively captured, narrow QRS configuration identical to the clinical VT was obtained with latency (Figure 1). However, radiofrequency (RF) energy application to this area was not effective in terminating the VT. An ablation catheter was introduced in the left ventricle, and Purkinje potential, which preceded QRS onset by 40 ms during VT, was recorded at the left posterior fascicle area, where Purkinje potential could also be recorded during sinus rhythm before QRS (Figure 2). RF energy application at this

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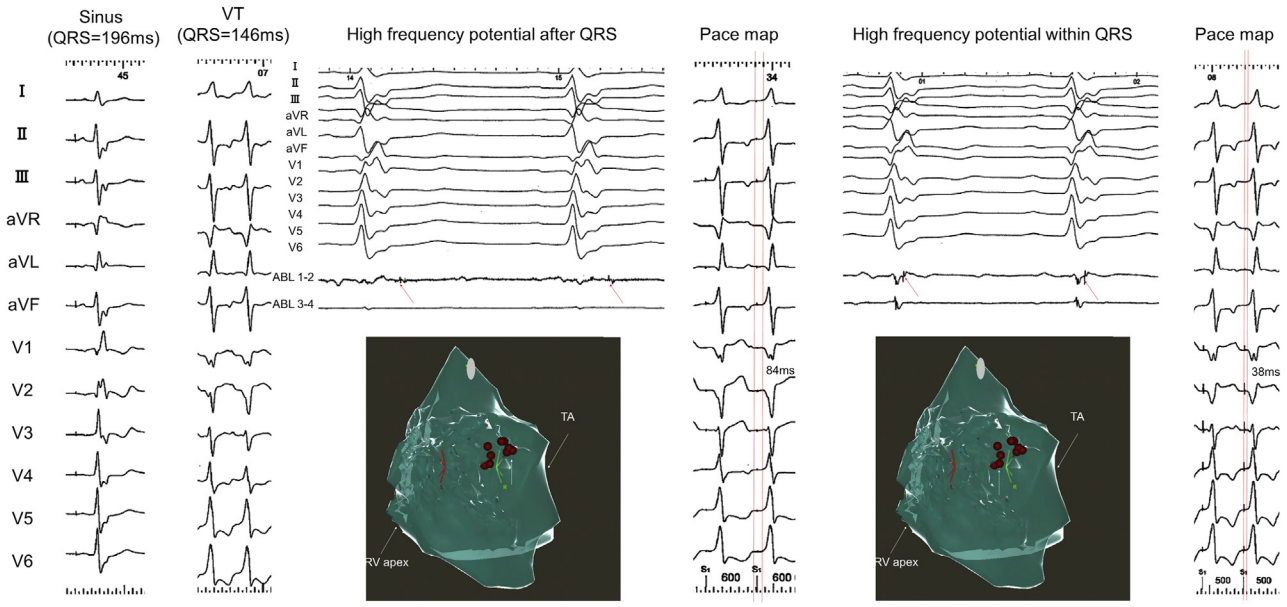

Figure 1 The focal Purkinje ventricular tachycardia (VT) with narrow QRS configuration and bystander delayed Purkinje potential at right ventricular septum. The focal Purkinje VT during the first procedure exhibited narrower QRS morphology (146 ms) than the native QRS (196 ms). High-frequency potential (*red arrow*) was recorded along the right ventricular septum after or within the QRS during sinus rhythm. Once this potential was selectively captured, narrow QRS configuration identical to the clinical VT was obtained with latency. Radiofrequency energy application to this area was not effective in terminating the VT, which indicates that the potential was bystander delayed Purkinje potential.

point eliminated this focal Purkinje VT and the targeted VTs did not recur after the procedure.

After 11 months, we performed repeat catheter ablation of highly symptomatic VT. The clinical VT occurred incessantly in nonsustained form with only 1 or 2 sinus beats between each VT, resulting in ICD therapy (Figure 3). A single premature ventricular contraction with the same QRS morphology was observed as well. A multipolar mapping catheter (PentaRay; Biosense Webster, Diamond Bar, CA) was introduced in the right ventricle and the high-frequency potential preceding QRS onset by 92 ms during VT (or premature ventricular contraction) was recorded around the right ventricular papillary muscle (Figure 3). During sinus rhythm, this potential was recorded not before but

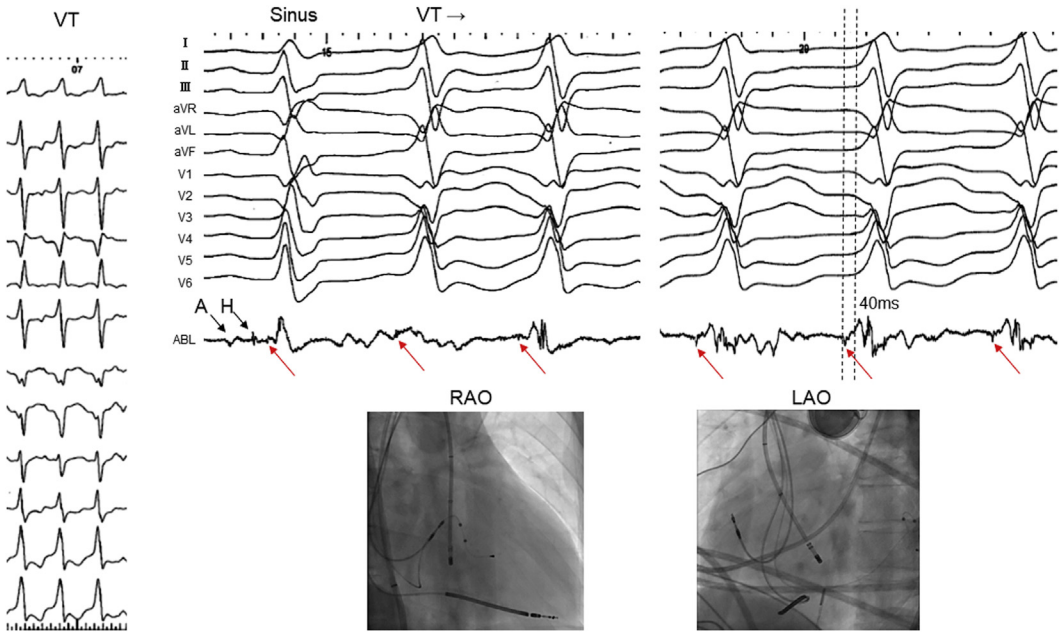

Figure 2 Successful ablation site for the focal Purkinje ventricular tachycardia (VT) with narrow QRS complex. The Purkinje potential that preceded QRS onset by 40 ms during VT (*red arrow*) was recorded at the left posterior fascicle area where the Purkinje potential could also be recorded during sinus rhythm before QRS (*dotted red arrow*). A = atrial electrogram; H = left side His electrogram. LAO = left anterior oblique; RAO = right anterior oblique.

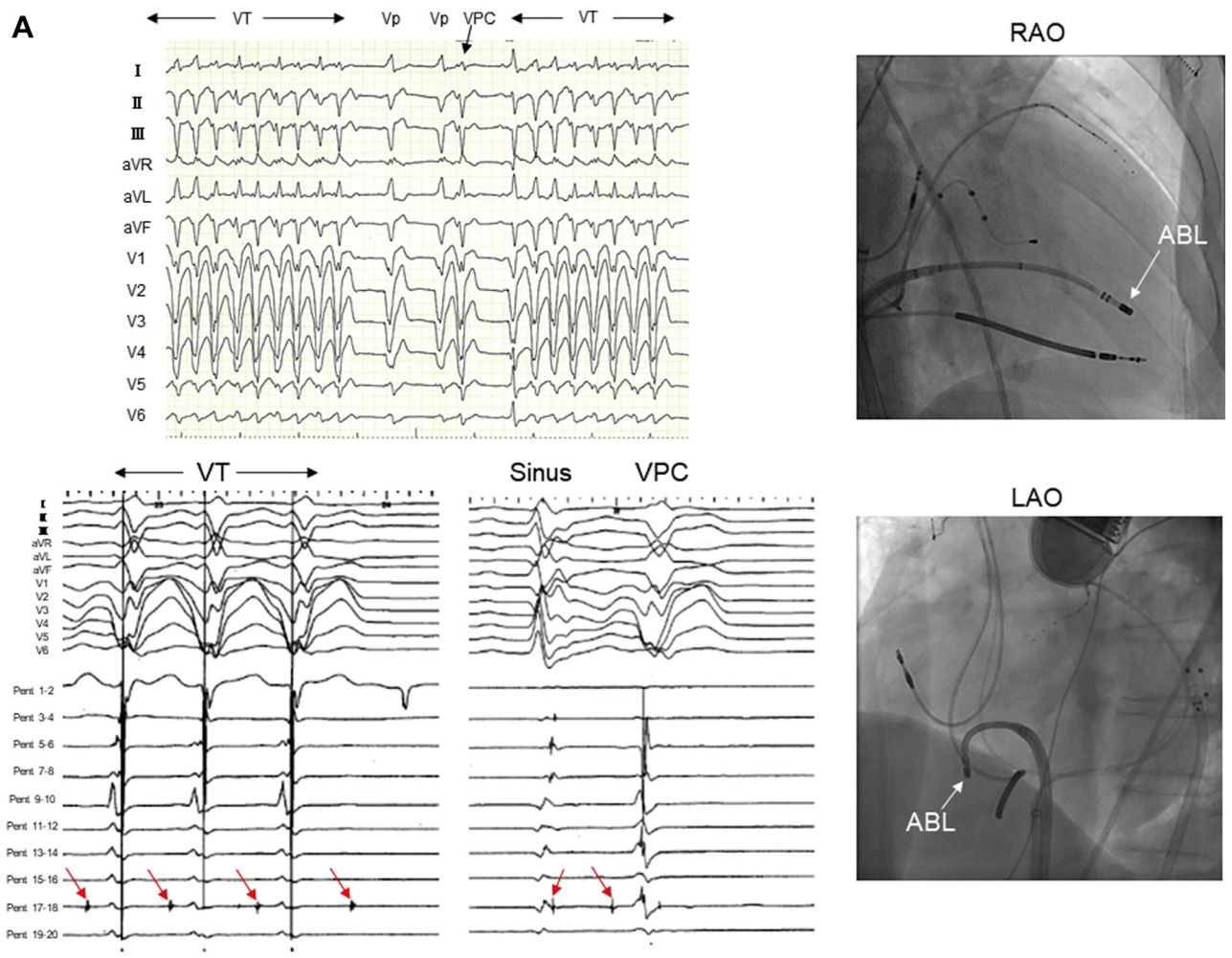

Figure 3 Successful ablation site for the focal Purkinje ventricular tachycardia (VT) during the second procedure. **A:** The VT occurred incessantly in a non-sustained form with only 1 or 2 sinus beats between each VT. High-frequency potential preceding QRS onset by 92 ms during VT was recorded around the right ventricular papillary muscle (*red arrow*). Conduction block was observed between Purkinje potential and local ventricular electrogram at the termination of VT. During sinus rhythm, this potential was recorded not before but after the far-field ventricular electrogram (*dotted red arrow*). **B:** The voltage map of the right ventricle revealed extensive scar on the septum. The intracardiac echocardiogram (ICE) image showed the ablation catheter was positioned at the right ventricular papillary muscle, which protruded into the right ventricular cavity. ABL = ablation catheter; LAO = left anterior oblique; LV = left ventricle; Pap Muscle = papillary muscle; RV = right ventricle; VPC = ventricular premature contraction.

after the far-field ventricular electrogram (Figure 3). A single RF energy application at this site eliminated the VT, which became noninducible. After the last procedure, the patient has been free from further VT episodes for more than 1 year.

Discussion

Cardiac sarcoidosis can affect the conduction system, which sometimes results in not only conduction block but Purkinje-related VTs as well. Naruse and colleagues[4] previously reported that 16% of VTs in cardiac sarcoidosis were Purkinje-related VT, including focal Purkinje VT.[4] In our case, the focal Purkinje VT during the first procedure was eliminated by ablation of the left posterior fascicular area where Purkinje potential was recorded before QRS during sinus rhythm. Although it was bystander, the high-frequency electrogram after or within QRS recorded along the right ventricular septum should be considered as the delayed right-sided Purkinje potential (or right bundle potential), since selective capture of this potential reproduced narrow QRS (narrower than native QRS) identical to the clinical focal Purkinje VT. The native QRS morphology exhibiting right bundle branch block and left anterior hemiblock would explain the difference in the timing of local Purkinje potential between the left posterior fascicular area and the right ventricular septum. For the same reason, the Purkinje potential associated with the recurrent focal Purkinje VT during the second procedure was recorded not before but after the far-field ventricular electrogram during sinus rhythm.

Although the Purkinje potential that precedes QRS onset during focal Purkinje VTs should also be recorded before QRS during sinus rhythm, the timing can be variable depending on the baseline conduction disturbance, as shown in the current case. Furthermore, the Purkinje potential recorded after QRS during sinus rhythm could be either the target (the recurrent VT during the second procedure) or the bystander

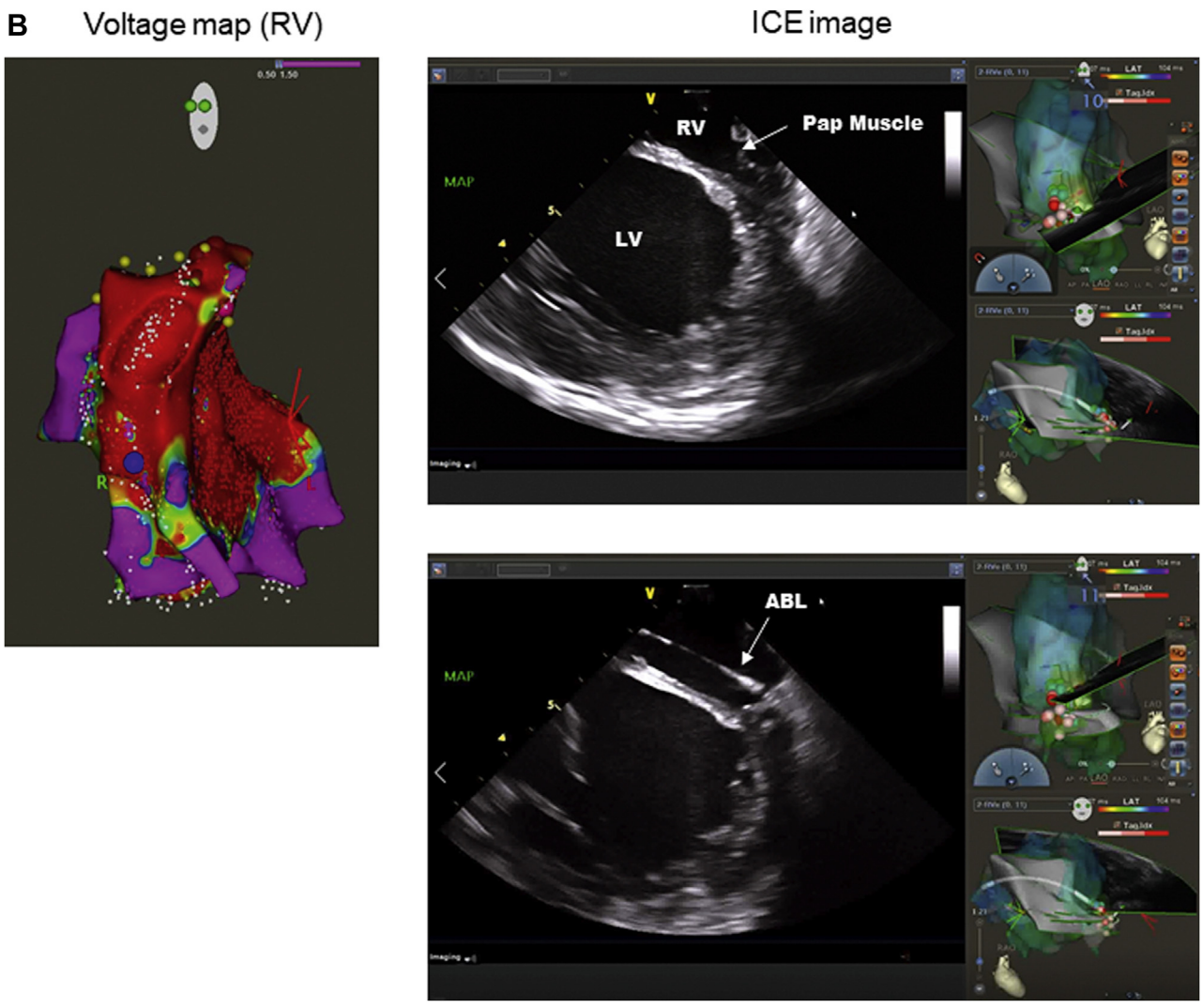

Figure 3 (*continued*).

(the initial VT during the first procedure) for the clinical focal Purkinje VT. This case report highlights the importance of mapping of the earliest Purkinje potential during VT regardless of the difficulty in inducing the clinical VT, since the local abnormal electrogram itself or pace-mapping findings during sinus rhythm would not be promising to decide optimal ablation sites.

Conclusion

In a case with focal Purkinje VT, the Purkinje potential that precedes QRS onset during VT can be recorded after QRS during sinus rhythm, depending on the baseline conduction disturbance. Since delayed Purkinje potential could be either the target or the bystander for the clinical Purkinje VT, mapping of the earliest Purkinje potential during VT is crucial regardless of the difficulty in inducing the clinical VT.

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