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SPOTLIGHT

Short-time ventricular tachycardia ablation for cardiac sarcoidosis using coherent map

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Abstract

A 69-year-old woman with isolated cardiac sarcoidosis was hospitalized for frequent appropriate implantable converter defibrillator therapies for ventricular tachycardia (VT) despite of favorably controlled condition with oral prednisolone. The patient underwent urgent catheter ablation with CARTO 3D mapping system. Although the voltage map, activation map, and propagation map during VT could not visualize the tachycardia circuit, the coherent map clarified entrance and exit sites of the tachycardia circuit with slow or nonconducting (SNO) zones, which seemed like a figure-of-eight circuit. Considering the risk of VT termination or acceleration to rapid unstable VT, neither entrainment nor pacing studies were performed. The VT was terminated near the exit site of the isthmus where tiny pre-systolic potential was detected. Any diastolic potentials could not be detected. This meant that the critical isthmus might be located at the epicardium or deep incite of the left-ventricular myocardium where the coherent map showed as SNO zones. We should recognize coherent map as artificial that may represent VT circuit as if complete endocardial reentry even if not. The procedural time from mapping to termination of VT was only 22 minutes. The patient has been free from any cardiovascular events after the procedure. Coherent map might be feasible for revealing the critical isthmus of hemodynamically stable VTs without using electrophysiological techniques, including entrainment, pacing study, and voltage map during own beats, and would enable us to achieve successful VT ablation in a short time.

KEYWORDS
cardiac sarcoidosis, catheter ablation, coherent map, ventricular tachycardia

A 69-year-old woman with isolated cardiac sarcoidosis was admitted to the emergency department with sustained ventricular tachycardia (VT). The patient has been diagnosed with isolated cardiac sarcoidosis based on clinical manifestations, 3 years ago. These manifestations included sustained VT, left ventricular (LV) systolic dysfunction (ejection fraction of 31%), late gadolinium enhancement on cardiac magnetic resonance imaging (Figure 1A), and focal-on-diffuse fluorodeoxyglucose (FDG) uptake on positron emission tomography (PET) (Figure 1B). At that time, a transvenous implantable converter-defibrillator (ICD) was implanted for syncope due to sustained VT. Moreover, sustained VT and persistent atrial fibrillation were treated with radiofrequency catheter ablation but failed. Oral prednisolone was administered at an initial dose of 30 mg daily, which was gradually tapered after confirming decreased FDG accumulation on PET (Figure 1C) and maintained

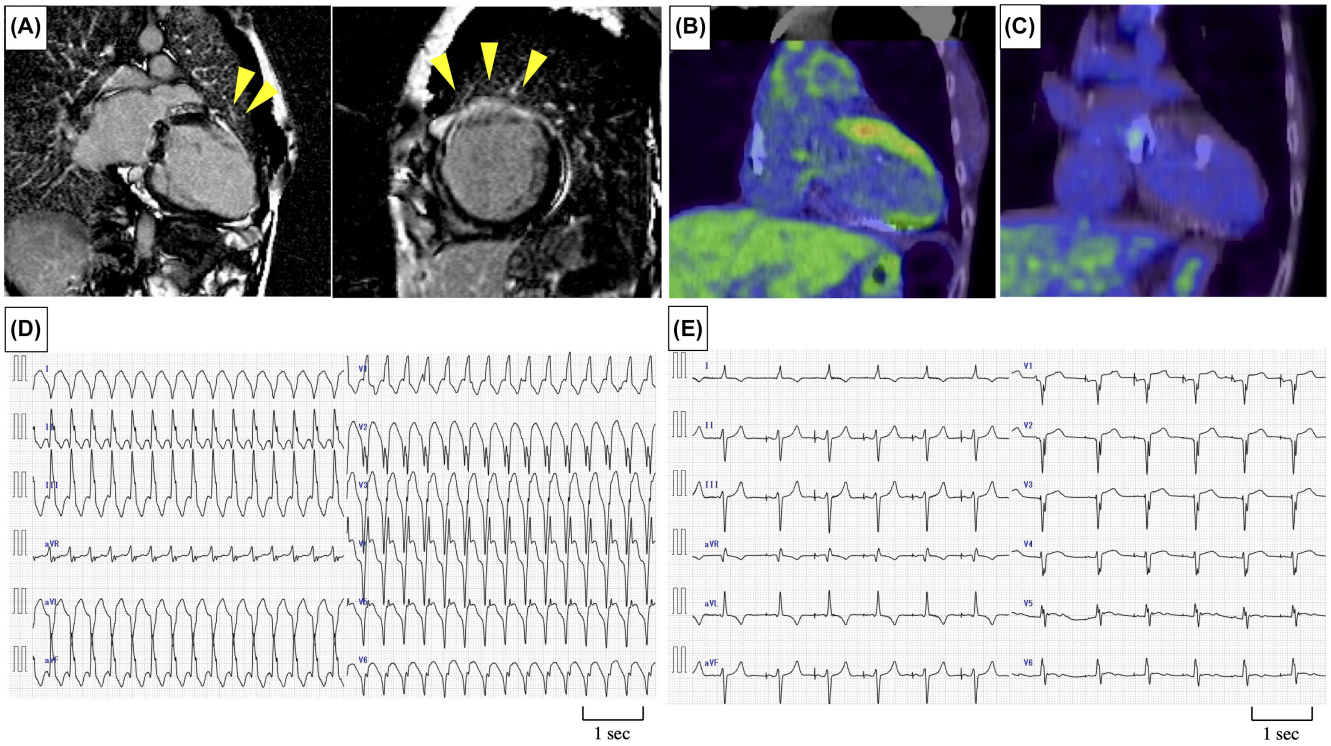

FIGURE 1 (A) Cardiac magnetic resonance imaging shows a transmural pattern of late gadolinium enhancement at the anterior LV wall (arrowhead). (B) Positron emission tomography demonstrates focal-on-diffuse fluorodeoxyglucose accumulation at the anterior LV wall. (C) After administration of prednisolone, abnormal fluorodeoxyglucose accumulation almost disappears. Electrocardiogram during ventricular tachycardia (VT) (D) and atrial-pacing rhythm (E).

on 8 mg daily as maintenance therapy. Despite corticosteroid therapy, frequent appropriate ICD therapies for sustained VT were initiated, and a repeated catheter ablation was scheduled. An electrocardiogram during VT showed a right bundle-branch block pattern with a superior axis (Figure 1D). After hospitalization, the VT was terminated by cardioversion. An electrocardiogram showed atrial pacing with preserved atrioventricular conduction, incomplete right bundle-branch block, and left anterior hemiblock (Figure 1E).

Since atrial tachycardia (AT) also occurred frequently, both AT and VT ablations were performed in one session. During transseptal mitral isthmus ablation of AT using the CARTO 3 system (Biosense Webster Inc.), monomorphic VT (tachycardia cycle length of 380 ms) was induced by mechanical stimulus during catheter manipulation. Since the patient was hemodynamically stable, LV endocardial map was created during VT using a PentaRay multipolar catheter (Biosense Webster Inc). Voltage map during VT revealed widespread low-voltage area (<0.5 mV) in the middle to apical lateral LV wall (Figure 2A). The activation map (Figure 2B) and propagation map (Video S1) showed the earliest activation site in the middle of the LV lateral wall. The total activation time was 234 ms, accounting for 62% of the tachycardia cycle length of 380 ms. Ripple bars could not visualize the VT circuit (Video S2). In a coherent map, conduction velocity vectors clarified entrance and exit sites of the circuit with slow or nonconducting zones (SNO zones), which seemed like a figure-of-eight circuit (Figure 2C, Video S3). Tiny pre-systolic potentials which preceded the QRS onset by 64 ms could be recognized near the isthmus exit site (Figure 2D). The mechanism of VT was strongly suspected as scar-related reentry because previous anti-tachycardia pacing by ICD could terminate VT. Considering the risk of VT termination or acceleration to rapid unstable VT, neither entrainment nor pacing studies were performed. Transaortic liner ablation with ThermoCool open-irrigated tip catheter (Biosense Webster Inc.) terminated VT near the exit site of the isthmus where tiny pre-systolic potential was detected (Figure 3A). The procedural time from mapping to termination of VT was only 22 min. Sustained VT became noninducible by any ventricular stimulation. There was no significant electrocardiographic change after ablation (Figure 3B). The patient was discharged 2 days after the procedure and was free from any cardiovascular events for 18 months.

Cardiac sarcoidosis commonly complicates VT. Medical therapy with corticosteroids and antiarrhythmic agents is recommended as the first step for controlling VT.[1] In cases of drug-refractory VT, catheter ablation is considered. Due to the presence of widespread scare-related areas with multiple reentry circuits, VT ablation of cardiac sarcoidosis is technically challenging with less favorable outcomes and a high recurrent rate.[2] Previously, the usefulness of a coherent map in VT ablation has been scarcely reported. In our case, although coherent mapping simply detected a figure-of-eight circuit and clarified isthmus, diastolic potentials could not be detected within SNO zones: only pre-systolic potentials near the exit site of the circuit could be recorded. This meant that the critical isthmus

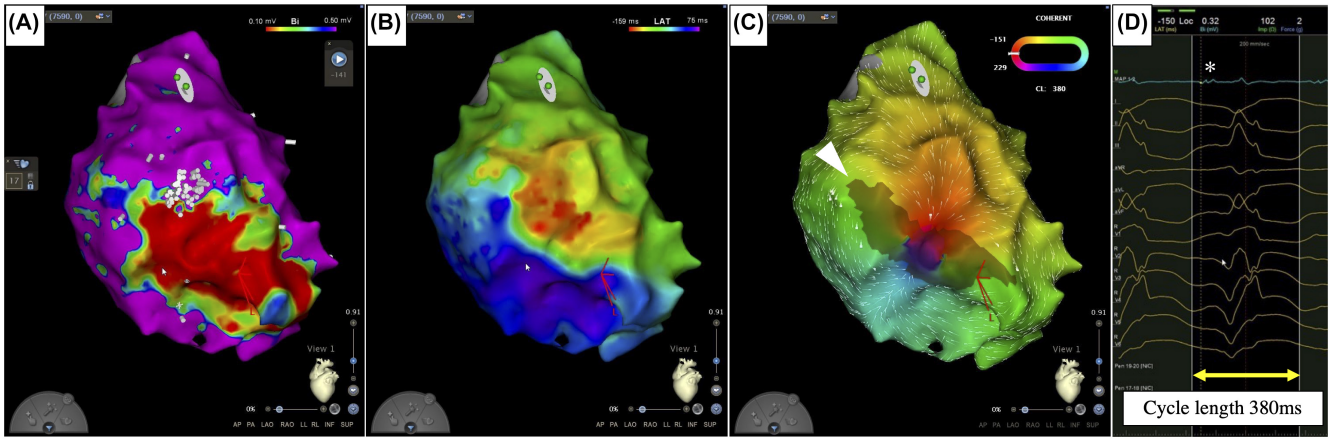

FIGURE 2 (A) Activation map during VT shows the earliest activation site in the mid-lateral LV wall. (B) Voltage map during VT reveals widespread low voltage area (<0.5 mV) in the middle to apical lateral LV wall. (C) In a coherent map, conduction velocity vectors simply clarify entrance and exit sites of the circuit with slow or nonconducting zones (arrowhead), which seems like a figure-of-eight circuit. (D) Intracardiac electrogram during VT records tiny pre-systolic potentials (asterisk), which precedes the QRS onset by 64 msec near the isthmus exit site.

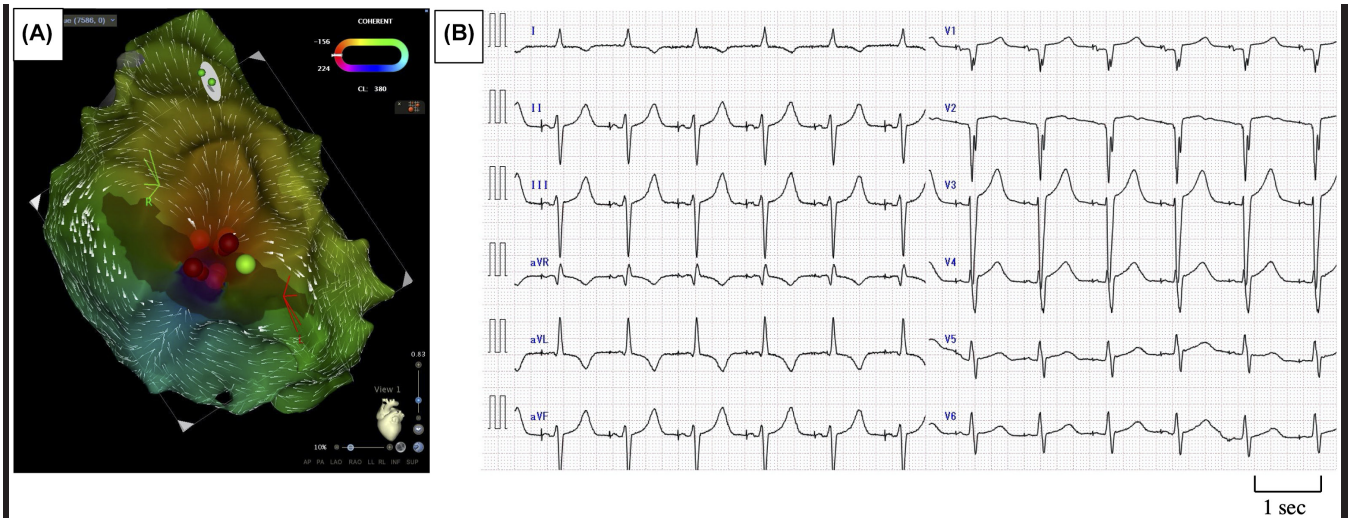

FIGURE 3 (A) VT is terminated near the isthmus exit site where the tiny pre-systolic potential is detected, which means that success point (green tag) is not on the critical isthmus but near the exit site of the VT circuit. (B) Electrocardiogram post-ablation.

might be located at the LV epicardium or deep incite of the LV myocardium where coherent mapping showed SNO zones.[3] We should recognize a coherent map as artificial that may represent the VT circuit as if complete endocardial reentry even if not. Nevertheless, coherent map certainly detected VT circuit and contributed to shorten the procedure time. Prolonged procedural time is associated with increased in-hospital mortality, particularly in patients with severely reduced ejection fraction.[4] Ablation of VT using a coherent map might be an effective and safe strategy for reducing in-hospital deaths. In conclusion, the coherent map might be feasible for revealing tachycardia circuits of hemodynamically stable VTs without using electrophysiological techniques, including entrainment, pacing study, and substrate map during own beats, and enable us to achieve successful VT ablation in a short time.

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CONFLICT OF INTEREST

None declared.

ETHICS APPROVAL

All procedures used in this research were approved by the Ethical Committee of Sakakibara Heart Institute.

INFORMED CONSENT

Informed consent was obtained from the patients.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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SUPPORTING INFORMATION

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