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CASE REPORT

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# Novel mapping algorithm during catheter ablation for ventricular parasystole originating from left anterior fascicle

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## Abstract

A 17-year-old woman presented with frequent palpitations and shortness of breath and was diagnosed with drug-refractory ventricular parasystole. We predicted that the parasystole originated from the left anterior fascicle (LAF). Detailed activation maps of both conduction systems, including the LAF, during sinus rhythm and ventricular parasystole were obtained using a parallel mapping system. We confirmed the earliest fascicular potential of the parasystole and performed catheter ablation with no complications. This novel mapping algorithm for simultaneous acquisition of multiple maps aided effective treatment of ventricular parasystole originating from the LAF.

KEYWORDS

ablation, fascicle, three-dimensional mapping, ventricular arrhythmia, ventricular parasystole

## 1 | INTRODUCTION

Idiopathic ventricular premature complexes (VPC) can occur from the left fascicular system.[1,2] There is a risk of left bundle branch block during catheter ablation for these lesions.[3] Pace mapping is ineffective in identifying the target site of VPCs.[1] Therefore, activation maps of presystolic fascicular potential during both sinus rhythm and VPCs enable precise ablation.[1-3] However, recent studies show that VPCs cause a position shift in three-dimensional (3D) mapping systems compared with the same endocardial position during sinus rhythm.[4] We report the successful treatment of a ventricular parasystole originating from the left anterior fascicle (LAF) aided by accurate evaluation of LAF conductions using a novel mapping algorithm: parallel mapping and LAT hybrid system.

## 2 | CASE REPORT

A 17-year-old woman presented to our hospital with frequent palpitations and shortness of breath. A 12-lead electrocardiogram revealed ventricular parasystole with a relatively narrow QRS duration (112 milliseconds), right bundle branch block type, and inferior axis morphology (Figure 1). High-burden (18 000/day) monofocal ventricular parasystoles were confirmed with a 24-hour Holter electrocardiogram. Echocardiography and cardiac magnetic resonance imaging showed no structural abnormalities. Oral administration of flecainide (100 mg/d) was ineffective. Consequently, we decided to perform catheter ablation.

We utilized a transaortic approach to access the left ventricle (LV) using 3D mapping via the CARTO 3 system version 7 (CARTO PRIME Module; Biosense Webster, Diamond Bar, CA). We predicted that the parasystole originated near the LAF. Therefore, a detailed activation map of the conduction system during sinus rhythm was necessary. Moreover, mapping of the earliest fascicular potential preceding the QRS onset of parasystole was attempted. Activation maps during sinus rhythm and parasystole were simultaneously obtained by the ThermoCool SmartTouch Surround Flow catheter (Biosense Webster) with a parallel mapping system and the filter Carto Confidense Module with Pattern Matching (Figure 2A,B). We limited the window of interest to between the His signal and before

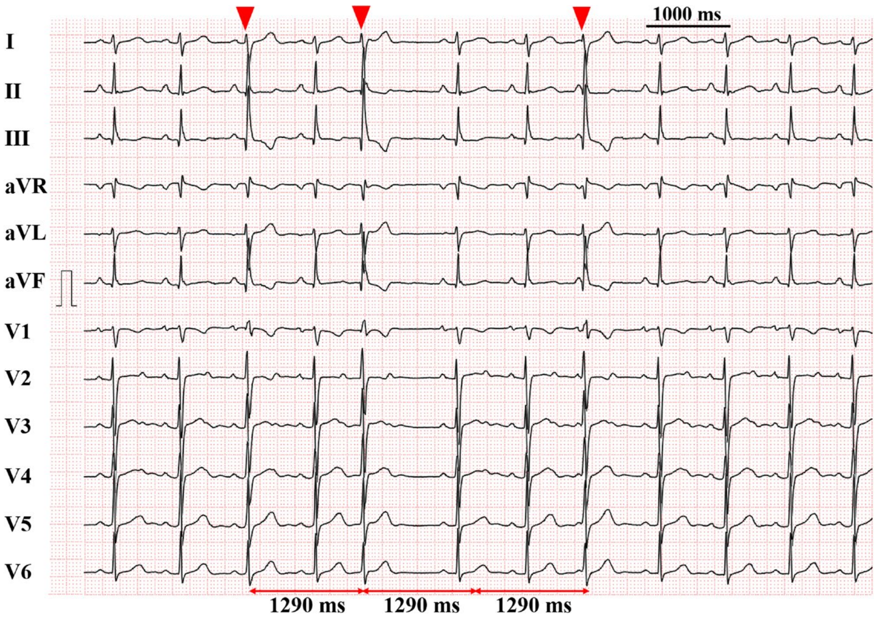


**FIGURE 1** A 12-lead electrocardiogram demonstrating parasystole. A 17-year-old woman presented with dyspnea and palpitations. A 12-lead electrocardiogram was performed and displayed parasystole (red arrow head) with a relatively narrow QRS duration (112ms), right bundle branch block type, and inferior axis morphology. QRS complexes of parasystole showed varying coupling but the same interectopic intervals (1290 ms)

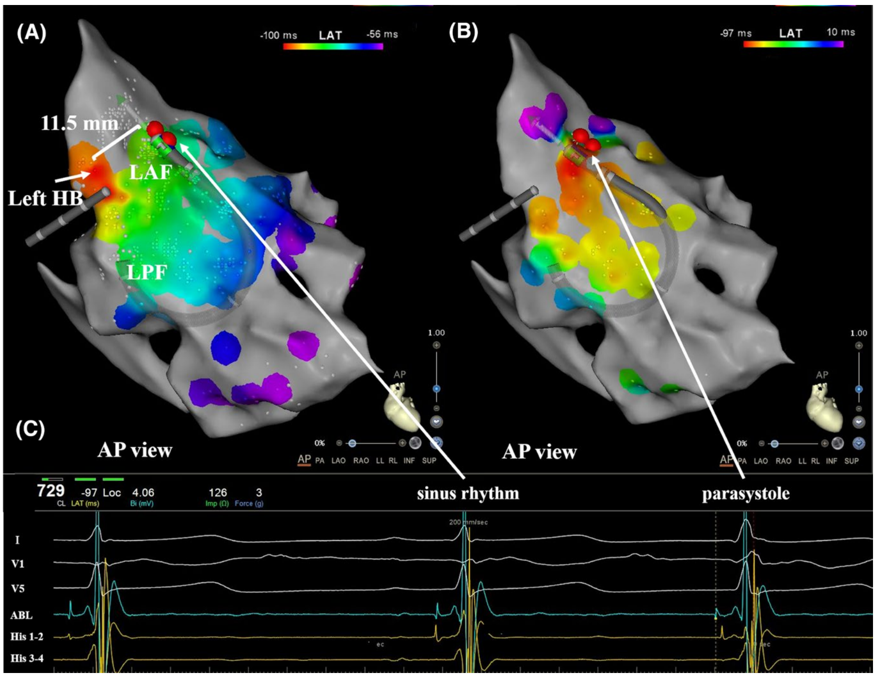


**FIGURE 2** Activation maps during parasystole and sinus rhythm with intracardiac electrograms. Parasystole in a 17-year-old woman experiencing dyspnea and palpitations was mapped using the CARTO 3 system version 7 (Biosense Webster, Diamond Bar, CA), and the filter Carto Confidense Module with Pattern Matching. We acquired the QRS morphology of sinus and parasystole beats and utilized a correlation threshold of ≧0.97. Any other functions for distinguishing the parasystole from sinus beat (ie, Cycle length, Tissue Proximity Indication) were not used. A, The activation map of conduction system of left ventricle (LV) during sinus rhythm in the anterior posterior (AP) view is shown. This map clearly demonstrates the conduction system, including the left side His bundle (Left HB), the left anterior fascicle (LAF), and the left posterior fascicle (LPF). The distance from the left side his and the targeted proximal LAF was 11.5 mm. B, The activation map during the parasystole of LV in the AP view is shown. The earliest site was close to the proximal end of the left anterior fascicle area. C, The intracardiac electrogram of this location demonstrated a pre-QRS potential preceding the QRS complex both during sinus rhythm and parasystole. The His potential shown in yellow was recorded at the right side. The sequence of pre-QRS fascicular potential during sinus rhythm and parasystole was reversed. These maps were simultaneously obtained using a parallel mapping. We delivered radiofrequency energy to the location shown by the red tag. ABL, ablation catheter

the QRS complex to record the electrograms of the conduction system in both maps. We also utilized the LAT-Hybrid system for points of the parasystole that were spatially displaced relative to the location in sinus rhythm. In 46 min, we simultaneously mapped 114 points of parasystole and 1006 points of sinus rhythm. We found from using the LAT-Hybrid system that the earliest activation site of parasystole was displaced by 5.8 mm from the sinus rhythm location toward the inferior direction (Figure S1). The earliest site during the targeted parasystole with clear prepotential preceding QRS of parasystole onset (−51 ms) was located close to the proximal end of the LAF (Figure 2A and 2B). Furthermore, a sharp presystolic fascicular potential could be clearly recorded both during sinus rhythm and parasystole (Figure 2C). Additionally, the sequence of the fascicular potential during sinus rhythm was from the His bundle to the earliest site (Figure 2C). However, during parasystole, the sequence of the fascicular potential from the earliest site to the His bundle (Figure 2C) and the activation of the fascicular potential from the earliest site to the left side His (Figure 2B) revealed that the origin of the parasystole was fascicular in the proximal LAF. The distance from the left side His and the targeted proximal LAF was 11.5 mm. Sufficient pace mapping was not performed because the targeted parasystole were frequently seen. We carefully delivered radiofrequency (RF) energy to that location (Figure 2A and 2B, red tag) with 25 watts for 30 seconds while the parasystole was present. However, the parasystole was not eliminated. The second RF application eliminated the parasystole and we continued for 60 seconds (Figure S2). After the second RF application, the administration of isoproterenol and phenylephrine did not induce any further parasystole, and complications, such as LAF block, were successfully avoided. The patient had an uneventful recovery after hospital discharge without recurrence.

## 3 | DISCUSSION

Our case report highlights that parallel mapping and the LAT-Hybrid system can be used to successfully treat ventricular parasystole originating from the LAF. This novel mapping algorithm makes it possible to obtain a sinus rhythm and parasystole activation map efficiently and identify a precise location during ablation by adjusting the position shift associated with the sinus and parasystole beats.

A previous report showed the distance between the origin of VPCs from LAF and His bundle was 7.3 ± 4.6 mm, and the complication rate of fascicular block after ablation was 18.5%.[3] For this type of arrhythmia, a detailed mapping of the His-Purkinje but not the earliest ventricular mapping is a necessary addition to avoid adversely impacting the conduction system.[1] Performing ablation at a more distal site from the origin of left fascicular ventricular arrhythmia is associated with an increased risk of shifting of the exit or circuit location.[5]

Normally, when two maps are necessary, the potential abnormality can only be visualized by switching between the maps, which can be time consuming. However, with parallel mapping, it is possible to obtain both activation maps simultaneously, decreasing the procedure time while also increasing the efficacy. The LAT-Hybrid system made it possible for precise positioning during ablation. Geometry of the presystolic ventricle is likely to differ during VPCs versus sinus rhythm and creating a map that corrects for this position shift has been effective for VPC ablation[4]. Here, we used the LAT-Hybrid system to automatically adjust for this displacement. Using this algorithm, only two points of ablation were needed to successfully eliminate ventricular parasystole originating from the LAF.

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## CONFLICT OF INTEREST

The authors declare no conflict of interests for this article.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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