

# Premature extrastimulus pace-mapping to identify the origin of ventricular premature depolarizations



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## Introduction

Frequent premature ventricular depolarizations (VPDs) may lead to the development of dilated cardiomyopathy, which is reversible with catheter ablation. Closely coupled VPDs have also been shown to trigger polymorphic ventricular tachycardia.<sup>1</sup> Twelve-lead electrocardiogram morphology and pace-mapping are useful clinical tools for localization of the site of origin of VPDs, particularly when the clinical VPD is infrequent during the electrophysiology study. However, pace-mapping has its limitations, as the paced QRS morphology may vary with current strength / pacing cycle length of coupling interval.<sup>2</sup> The effect of these variables on the QRS morphology may be accentuated in particular anatomic locations, such as the interventricular septum. We describe unique mapping and ablation results from 2 VPD ablation cases, where premature extrastimulus pace-mapping identified the origin of VPD.

## Case reports

### Case 1

A 40-year-old man with symptomatic VPDs with a left bundle inferior axis (Figure 1A) was refractory to medical therapy and was referred for ablation. A standard stimulation protocol comprising 8 consecutive stimuli at a fixed cycle length (S1) of 600 or 500 ms (determined by underlying heart rate), followed by a single extrastimulus (S2), was performed at diastolic capture threshold. Good pace maps were recorded from right ventricular outflow tract septum pacing and with premature extrastimuli

**KEYWORDS** Pace-mapping; Prematurity; Ventricular premature depolarizations; Catheter ablation; QRS morphology

**ABBREVIATIONS** LVOT = left ventricular outflow tract; SHD = structural heart disease; VPD = premature ventricular depolarizations (Heart Rhythm Case Reports 2016;2:24–26)

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pacing at a coupling interval of 300 ms from the right coronary cusp (Figure 1A). Radiofrequency energy was delivered successfully from the right coronary cusp at the site of the good pace map match and the earliest activation (Figure 1B).

### Case 2

A 57-year-old man with symptomatic VPDs with a right bundle inferior axis (Figure 2A) that was refractory to medical therapy presented for catheter ablation. The same pacing protocol as case 1 was performed. The best pace-mapping QRS match was observed by delivering premature extrastimuli at the left coronary cusp at a coupling interval of 300 ms (Figure 2A). Radiofrequency energy was delivered successfully from the left coronary cusp at this site (Figure 2B).

## Discussion

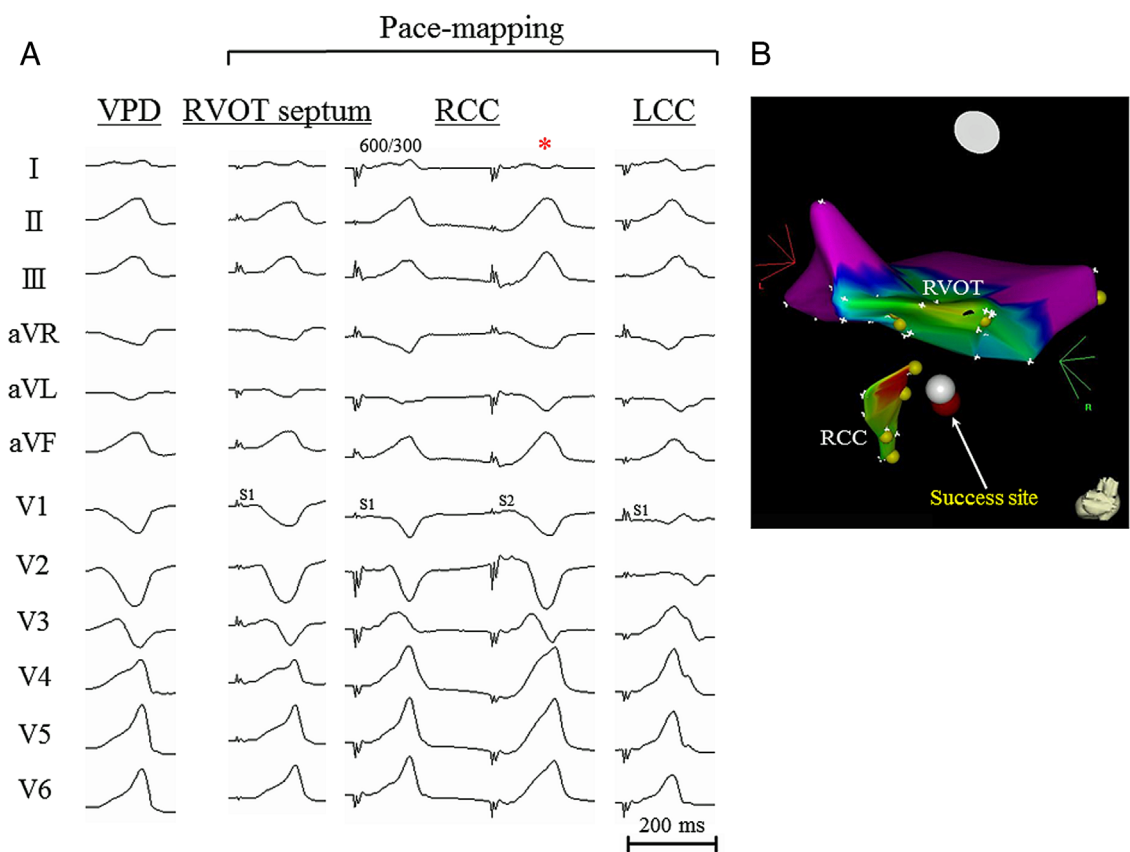
Assessing the QRS morphology with premature extrastimuli can help to identify the origin of VPDs and the best site for catheter ablation. Interestingly, the QRS morphology of extrastimulus pacing exhibited a pace map match for the clinical VPD superior to the conventional drive train pacing at these sites, indicating the importance of using a shorter coupling interval at this anatomic location. Yamada et al<sup>3</sup> reported that preferential conduction could be observed with left ventricular outflow tract (LVOT) VPDs exhibiting multiple exits. The property of preferential conduction in the LVOT may be the mechanism that leads to variable electrocardiogram morphologic features. In our cases, each outflow tract site of origin was located in the LVOT adjacent to the interventricular septum. Since intramural VPDs demonstrate preferential conduction with multiple exits, pace-mapping from the outflow tract with shorter coupled extrastimuli may also delineate multiple exits and yield different paced QRS morphologies. In addition, changes related to the altered coupling interval of the wavefront of activation of the premature stimulus may alter both refractoriness and conduction of surrounding myocardium, which in turn may alter subsequent activation

**KEY TEACHING POINTS**

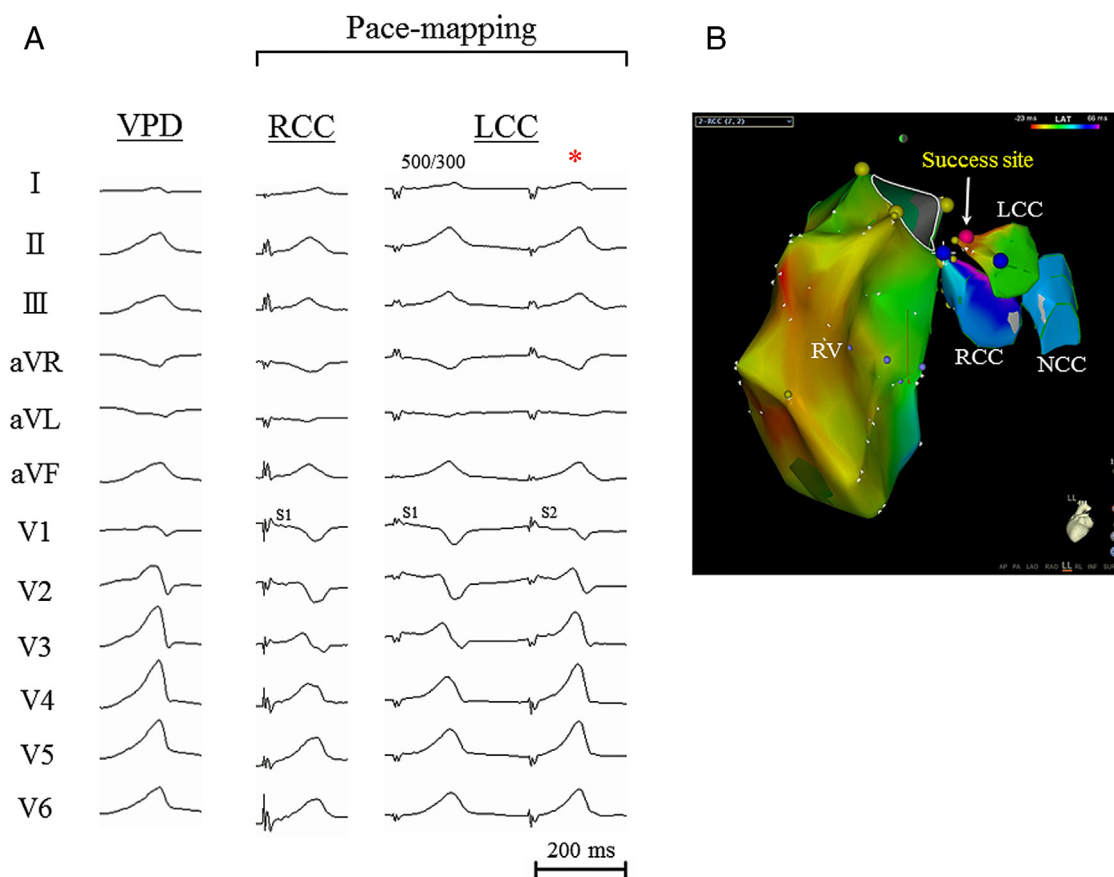
- Assessing the QRS morphology with premature extrastimuli can help to identify the origin of premature ventricular depolarizations and the best site for catheter ablation.
- The QRS morphology of extrastimulus pacing exhibited a pace map match for the clinical premature ventricular depolarizations superior to the conventional drive train pacing at the left ventricular outflow tract, indicating the importance of using a shorter coupling interval at this anatomic location.
- Premature extrastimulus pacing may be necessary to uncover the identical pace-mapping QRS morphology from the same pacing site before proceeding to an alternative anatomic site.

approach may be useful for in idiopathic arrhythmias. Since we evaluated only patients without structural heart disease (SHD), our results cannot be extrapolated to patients with SHD, and further studies in patients with SHD are warranted. Additionally, the effect of pacing at different drive trains (eg, 500, 400, 300 ms) was not evaluated.

wavefronts, resulting in slow conduction or unidirectional block dramatically changing the QRS complex.<sup>4</sup> This



**Figure 1** Images highlight the right coronary cusp (RCC) as the site of origin for the clinical premature ventricular depolarizations (VPDs). Delivery of premature pacing extrastimulus (\*) from the RCC achieved an improved pace map match correlating with the QRS morphology of the clinical VPD. **A:** Electrocardiographic correlation of pace maps from premature extrastimulus pacing to clinical VPD. **B:** Successful ablation site on the CARTOSound reconstruction of the right ventricular outflow tract (RVOT) and RCC. LCC, left coronary cusp.



**Figure 2** Representative case of left coronary cusp (LCC) origin premature ventricular depolarization (VPD). Pacing prematurity (\*) from the LCC matched the QRS morphology of VPD. **A:** Clinical VPD and electrocardiograms of pace-mapping. **B:** Successful ablation site. NCC, noncoronary cusp; RCC, right coronary cusp; RV, right ventricle.

## Conclusion

Premature extrastimulus pacing may be necessary to uncover the identical pace-mapping QRS morphology from the same pacing site before proceeding to an alternative anatomic site.

## References

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