EDITORIAL

High-Power Short-Duration Ablation for Basal Cardiac Crux PVCs: Anatomical Precision Meets Technological Evolution

Serkan Cay, MD*

Note

See related article, Karacali et al. 2025;3(3): pages 34-37.

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Correspondance*

Serkan Cay, MD

cayserkan@yahoo.com

Division of Arrhythmia and Electrophysiology, Department of Cardiology, University of Health Sciences, Yuksek Ihtisas Cardiovascular Building, Ankara City Hospital, Ankara, Turkey

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The case report by Karacali et al.[1] describes successful endocardial high-power short-duration (HP-SD) radiofrequency ablation of premature ventricular contractions (PVCs) originating from the basal cardiac crux. This report contributes meaningfully to the evolving understanding of complex inferoseptal ventricular arrhythmias (VAs), particularly in anatomically intricate regions where procedural risk is non-trivial.

Anatomical and Electrophysiological Context

The cardiac crux is a pyramidal quadrangular region where the right atrium, left atrium, right ventricle, and left ventricle converge. It encompasses the proximal coronary sinus (CS), posterior descending artery (PDA), epicardial fat, and is closely related to the atrioventricular (AV) conduction system. This complexity renders mapping and ablation particularly challenging.

Ventricular arrhythmias arising from the cardiac crux frequently exhibit a superior axis, demonstrate either left or right bundle branch block (LBBB or RBBB) morphology depending on the site of origin, present with a wide QRS duration, and are characterized by a maximum deflection index (MDI) ≥ 0.55 and a pseudo-delta wave duration ≥ 34 ms. These ECG criteria have been validated as markers of epicardial origin.[2,3] The reported MDI of 0.62 and pseudo-delta of 50 ms in the present case are highly consistent with an epicardial substrate, yet the arrhythmia was successfully eliminated via an endocardial approach—highlighting the importance of careful electroanatomic correlation.

Recent mapping studies using high-density systems confirm that basal crux PVCs may have preferential conduction pathways enabling successful endocardial ablation despite apparent epicardial ECG characteristics.[4,5]

Diagnostic Differentiation: Basal Crux vs Inferoseptal Process (ISP)

A clinically important contribution of this report is the differentiation between basal crux and inferoseptal process (ISP) PVCs. ISP arrhythmias can mimic crux morphology on surface ECG and often require multipoint mapping across LV, RV, and CS. Contemporary literature suggests that DIII > DII R-wave amplitude and early LV posteroseptal activation favor basal crux origin.[6] The absence of earlier activation near the ISP in this case strengthens the anatomical diagnosis.

Advanced electroanatomical mapping systems (e.g., HD Grid technology used in this report) improve spatial resolution and may reduce the need for epicardial access in selected cases. This aligns with 2024–2025 data demonstrating improved procedural precision using multipolar high-density catheters in complex ventricular substrates.[5]

High-Power Short-Duration (HP-SD) Ablation: Expanding Beyond AF

High-power, short-duration (HP-SD) ablation has been extensively investigated in atrial fibrillation; however, its application in ventricular arrhythmias is more recent. The underlying rationale includes the creation of wider and shallower lesions, reduced conductive heating, minimization of collateral injury, shorter procedural times, and the potential for improved lesion durability.

The FAST and FURIOUS study series demonstrated safety and improved lesion control with very-high-power short-duration strategies.5 Although largely AF-focused, mechanistic principles apply to ventricular tissue, particularly in anatomically sensitive zones.

Recent ventricular data suggest HP-SD improves acute success rates in outflow tract VAs with shorter RF time and similar safety profile compared to conventional ablation.[6] While ventricular myocardium is thicker than atrial tissue, basal crux substrates may not require deep transmural lesions—making HP-SD mechanistically attractive.

In the present case, conventional 40 W ablation failed to suppress PVCs, whereas >50 W for 8 seconds achieved immediate elimination without complication. This supports emerging evidence that lesion geometry rather than duration alone determines efficacy.

Safety Considerations in the Cardiac Crux

The cardiac crux is anatomically adjacent to the atrioventricular (AV) node and His bundle, the coronary arteries, the coronary sinus and surrounding venous system, as well as epicardial fat. Consequently, the risk of collateral damage in this region is significant. Deep conductive heating during conventional radiofrequency ablation may endanger these neighboring structures. High-power, short-duration (HP-SD) ablation minimizes deep thermal spread by emphasizing resistive heating over conductive propagation, thereby potentially reducing injury to adjacent tissues.[7] Importantly, no AV block or coronary complication occurred in this case, supporting the hypothesis that controlled HP-SD delivery may offer a safer energy profile in crux ablation when carefully applied. However, long-term lesion durability and late coronary effects require further evaluation in ventricular applications. Multicenter prospective data are currently limited.

Clinical Implications

This report reinforces several important clinical insights. First, comprehensive multipoint mapping is mandatory in inferoseptal ventricular arrhythmias (VAs), as reliance on surface ECG characteristics alone is insufficient to reliably differentiate an inferoseptal process from a crux origin. Second, successful endocardial ablation may still be achievable despite the presence of epicardial ECG markers, highlighting the importance of thorough substrate assessment before pursuing epicardial access.

Moreover, high-power, short-duration (HP-SD) ablation may represent a safe and effective strategy in anatomically complex ventricular regions, where minimizing deep conductive heating is critical to reduce collateral injury.

Finally, premature ventricular contraction (PVC)–induced cardiomyopathy remains a reversible entity when effective arrhythmia elimination is achieved. In this case, the patient's reduced ejection fraction (35%) and subsequent symptom resolution following ablation underscore the importance of early interventional management in patients with high-burden PVC cardiomyopathy.

Limitations and Future Directions

As a single-case report, the generalizability of these findings remains inherently limited. Future investigations should therefore prioritize prospective comparisons of high-power, short-duration (HP-SD) versus conventional ventricular ablation strategies, particularly with respect to efficacy, safety, and procedural efficiency. In addition, detailed lesion depth modeling within ventricular myocardium is needed to better characterize biophysical effects in thicker myocardial substrates.

Long-term data regarding recurrence rates and safety outcomes are also essential, as durable success and avoidance of late complications remain central to clinical adoption. Further research should explore the potential role of adjunctive strategies—such as bipolar ablation or half-normal saline irrigation—in managing crux-related ventricular arrhythmias, where lesion depth and intramural substrates may pose challenges. Moreover, the integration of intracardiac echocardiography (ICE) for real-time anatomical guidance and safety monitoring warrants systematic evaluation in anatomically complex regions.

As of 2025, randomized data in ventricular substrates remain sparse, underscoring the need for well-designed multicenter trials to define optimal energy delivery strategies in ventricular arrhythmia ablation.

Conclusion

Karacali et al. present a technically sound and clinically relevant example of successful HP-SD ablation of basal cardiac crux PVCs. The case illustrates the importance of detailed anatomical mapping, ECG pattern recognition, and evolving ablation technologies. HP-SD strategies may offer meaningful advantages in anatomically complex ventricular arrhythmias, but systematic evidence is needed to define optimal power-duration parameters and long-term safety. This report contributes to the growing body of literature advocating precision-based ablation in structurally complex cardiac regions.

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Conflict of Interest

None

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