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COMMENTARY

# The era of muti-electrode mapping catheters and ventricular arrhythmia ablation

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As a fundamental aspect of the electrophysiological study, electroanatomic mapping serves as a critical tool for characterizing myocardial voltage and activation. Particularly for ventricular tachycardia (VT) ablation, mapping plays a pivotal role in pinpointing sites critical for sustaining reentry [1–5]. Mapping during VT can be challenging due to hemodynamic and electrical instability, and VT may be non-inducible at the time of study [4, 5]. Consequently, "substrate mapping" which can be safely performed in sinus rhythm or during pacing has garnered support [4, 5]. In addition to defining voltage, various methods for substrate characterization have been described, including the identification of abnormal ventricular activation, late potentials, and isochronal mapping [4, 5]. While traditional point-by-point (PbP) mapping with a single bipole can be performed, this labor-intensive process can be tedious with only one point collected per heartbeat [1]. Additionally, single bipole catheters with large electrodes and spacing have low tissue resolution and can misclassify floating myocardial bundles as dense scars [4]. In contrast, multielectrode mapping catheters (also known as multipolar mapping catheters or "MPMC") allow the collection of simultaneous electrograms from multiple sites during each beat, obtaining thousands of high-resolution points within minutes, improving resolution and acquisition speed [1, 4]. This offers similar advantages for premature ventricular contraction (PVC) mapping, especially when burden is low at the time of study.

Several popular MPM catheters are available, each with unique strengths and limitations. The Orion features a basket-shaped design with 64 electrodes; however, the spherical shape can be cumbersome around the papillary muscles, highly trabeculated myocardium, or along the epicardium [2]. The Pentaray and Octaray have multiple flower-shaped splines with 20 and 48 electrodes, respectively, but mapping in trabeculated ventricular myocardium can be challenging, as the freely floating splines may cause ectopy [2]. The Advisor HD Grid, with its paddle-shaped construction featuring 16 equally spaced electrodes, has gained popularity in mapping ventricular arrhythmias [2]. The smooth design allows rapid high-density mapping while being less prone to causing ventricular ectopy. In addition, the evaluation of activation between bipoles can be used to characterize wavefront propagation [6].

Despite the advantages, multielectrode data collection is not without limitations. One major concern is that standard bipolar mapping may fail to appropriately characterize propagating wavefronts oblique to catheter bipoles. This phenomenon, based on variable catheter angle of incidence to the myocardial wavefront, is known as bipolar blindness [3, 4]. These variations can lead to discrepancies in electrogram configuration and bipolar voltage, negatively influencing tissue characterization [4]. For the Grid catheter, various strategies outside of the standard bipolar settings were developed to address this challenge, such as "HD wave solution" and "omnipolar mapping" [3]. However, these solutions rely on algorithmic interpretation of the raw bipole recordings, and prospective data supporting efficacy is sparse [3].

In this volume of the Journal of Interventional Cardiac Electrophysiology, Tan et al. present a retrospective 20-patient study evaluating the safety and efficacy of the recently released Optrell MPMC during ablation of ventricular arrhythmias. The Optrell features a paddle-shaped design with 48 fixed electrodes evenly distributed across six parallel splines. This offers the advantage of rapid high-density mapping in challenging ventricular regions with potentially less catheter ectopy than seen with free-floating splines, such as with the Pentaray or Octaray. In addition, it features "local conduction vectors" (LCVs) to characterize wavefront propagation based on unipolar signals, avoiding

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bipolar blindness. While the design has generated considerable excitement, it remains a relatively new product with limited real-world data.

Tan et al. give the first description of a series of patients who underwent ventricular mapping with Optrell prior to ablation of VT and PVCs. Among the 13 VT patients, all had at least one complete high-density map. Twenty-eight maps were created in total (7 activation maps during VT and 21 voltage/ILAM maps during sinus or paced rhythm). Each map featured a median of 2753 points in the endocardium and 12,830 points in the epicardium, with a median time per map of 22 min for the endocardium and 60 min for the epicardium. Procedural success leading to the elimination of any inducible monomorphic VT was met in 8 of the 9 patients (89%) with MMVT inducible at baseline. There were no adverse events related to the use of Optrell, specifically no pericardial effusions or change in valvular regurgitation after the case.

To provide context, we can refer to a publication by Proietti et al. [7] in 2021 comparing VT mapping between the HD Grid, Pentaray, Duodeca, and PbP ablation catheter. The HD Grid demonstrated the best results, featuring a mean substrate mapping time of 37 min with a mean of 2687 points, compared to Pentaray (63 min for 1426 points), Duodeca (55 min for 1256 points), and PbP (96 min for 207 points) [7]. Elimination of all clinically inducible MMVT by the end of ablation was 26/33 (79%) when mapped with the Grid, 12/22 (55%) for Pentaray, 10/12 (83%) for Duodeca, and 2/6 (33%) for PbP [7]. These are statistically challenging comparisons in small numbers of patients, but results do highlight a trend favoring modern high-density mapping and the Grid. Notably, Tan et al.'s experience with the Optrell featured similar mapping time, point acquisition, and successful endpoint as the Grid.

In addition, Tan et al.'s report provides valuable insights into various anatomic approaches including transseptal, retroaortic, and epicardial approaches, specifically describing the technique of crossing the aortic valve directly rather than prolapsing the catheter in the descending aorta. Furthermore, the authors provided valuable insight into navigating challenging areas such as the trabeculated endocardium or the subvalvular apparatus. Interestingly the operators reported less catheter ectopy when using the Optrell compared to other MPMCs, similar to anecdotal experiences with the Grid.

In summary, this publication by Tan et al. offers early real-world data demonstrating promising safety and efficacy when using the Optrell MPMC for mapping ventricular arrhythmias. While the population size was small, the high-density mapping was rapid and reproducible, and the results offer strong support for future prospective studies to investigate Optrell in comparison to other multipolar mapping catheters and standard bipolar data acquisitions.

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## Declarations

**Conflict of interest** The authors declare no competing interests.

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