Use of novel electrogram to detect critical isthmus and abnormal potentials for ablation in ventricular tachycardia

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Topic(s): Ablation of Ventricular Arrhythmias

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Introduction
Automatic mapping systems aid rapid acquisition of activation maps. However, they may annotate farfield rather than nearfield signal in low voltage areas, making maps difficult to interpret. We report use of a novel algorithm in VT ablation. It analyses the complete electrogram (EGM) tracing, therefore preferentially including nearfield over farfield signals in its analysis.

Methods
22 patients with ischaemic cardiomyopathy and 3 patients with repaired Tetralogy of Fallot (ToF) underwent mapping using the ultra-high density Rhythmia system. These novel algorithms were applied retrospectively.

Results
In all LV substrate maps, changing the window of interest to the post-QRS phase automatically identified late potentials. In 21 of 23 LV VT activation maps, a minimum spatial window of interest correctly identified the VT isthmus as seen by the manually annotated map and response to ablation. In 5 maps, the algorithm identified the isthmus where the standard automatically annotated map did not. In the 3 RV maps, the split activation search algorithm identified the line of block at the ventriculotomy scar and persistent conduction on either side.

Conclusion
The algorithm automatically highlights areas with EGMs having specific characteristics or timings. This identifies late and fractionated potentials and regions that exhibit discontinuous activation, as well as the VT isthmus. These features may enhance human interpretation of EGM signals, particularly where the circuit lies in partial scar with low amplitude nearfield signals, and allow a more targeted ablation strategy.

Figure:
(A) Traces from ECG, RV diagnostic catheter and LV Orion. The window of interest (green bar) covers the post-QRS period. The roving probe EGM shows a late potential (yellow star).
(B) LV SR substrate map. White stars represent LAVAs. White dots represent lines of block along the lateral aspects of the isthmus projected from the VT activation map (H). Late potentials are highlighted by the algorithm.
(C) The complex activation search feature, with window of interest set in the post-QRS period, identifies a subset of late potentials with fractionated signal, which corresponds to maps with these signals annotated manually (white stars). The area highlighted corresponds to the VT isthmus as demonstrated on the
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(E) Activation map with atrial pacing. (F) demonstrates the group re-annotation feature, which annotates highlighted electrograms to the time-period of interest. The post-QRS phase has been highlighted to show late activation of near-field signals.

(G) The grey Skyline graph shows region size activated across the cycle length of the tachycardia. The portion of the tachycardia cycle which corresponds to the smallest region activated, as shown in the green portion of the Skyline graph, is highlighted on the activation map (H) and identifies the critical isthmus.