NOVEL "LATE POTENTIAL MAP" ALGORITHM: ABNORMAL POTENTIALS AND SCAR CHANNELS DETECTION FOR VENTRICULAR TACHYCARDIA ABLATION

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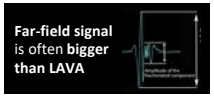
Background

Automated systems for substrate mapping in context of ventricular tachycardia (VT) ablation may annotate far-field rather than near-field signals, rendering the resulting maps hard to interpret.



We developed a new Late Potential Map (LPM) software, integrated in a non-commercial version of Carto. It is composed by a **local abnormal ventricular activity** (LAVA) annotation algorithm, which aims to provide a reliable annotation of near-field signals; and an algorithm for automatic regional vector analysis, which determines the wavefront direction and **local conduction velocity** (LCV).

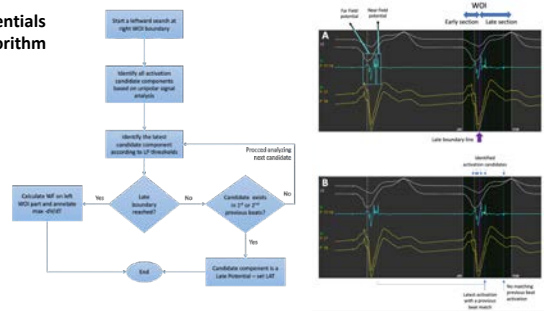
Aims

To evaluate whether the new LPM algorithm provides a reliable annotation of complex electrograms (EGM) and to explore if LCV analysis facilitates the recognition of intra-scar conduction corridors acting as VT isthmuses.

1 LPM ALGORITHM DEVELOPMENT

- "Development cohort": offline analysis of 10 high-resolution substrate LV maps
- All 23,803 EGMs were manually annotated by a single operator (NCD) and the unipolar and bipolar EGMs were analyzed regarding the signal morphology and dV/dT, and the best cutoffs to distinguish near-field from far-field EGM components were determined.

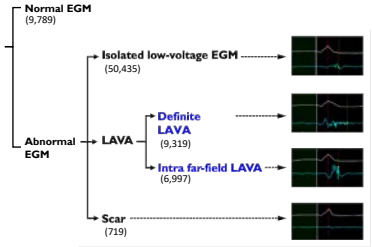
Late Potentials Map algorithm



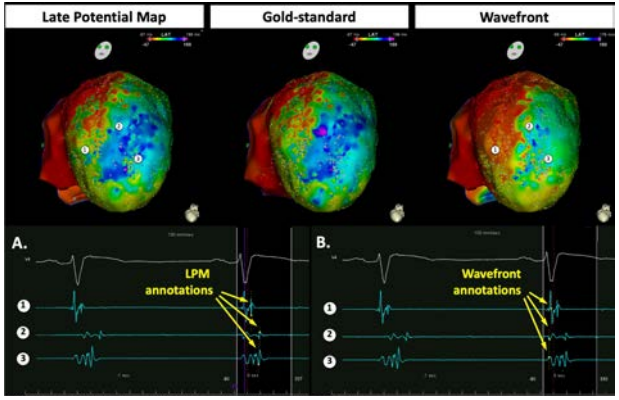
2 LPM ALGORITHM VALIDATION

- In 16 patients submitted to scar-related VT ablation, 8 VT activation maps and 29 substrate maps from different activation wavefronts were obtained.
- In offline analysis, LPM algorithm was compared to manually annotated substrate maps.
- All EGM in all the maps were reviewed by two operators (NCD and GLS).
- Locations of the VT isthmuses were compared with the substrate maps regarding LCV.

EGM classification of the 77,259 signals



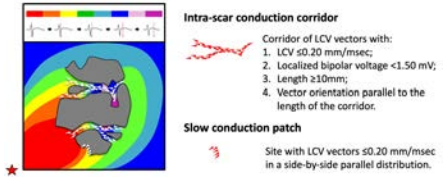
- LPM algorithm had an overall /LAVA annotation accuracy of 94.5%/81.1%, which compares to 83.7%/23.9% for the Wavefront.
- Performance was especially good in areas of low voltage, resulting in a reliable annotation of the near-field signals.
- Resultant maps presented a **spatial concordance** of 88.1% in delineating regions displaying LAVAs, which compares to 25.4% with the Wavefront.

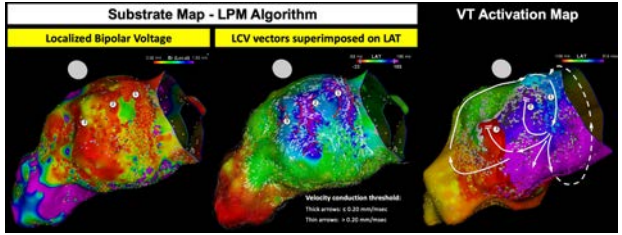


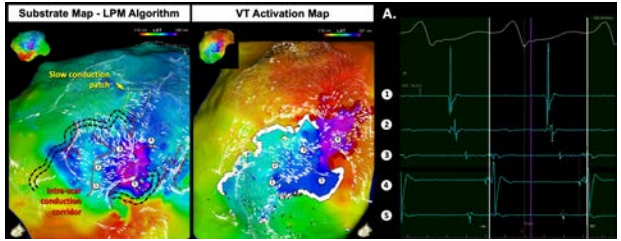
Accuracy of the automatic annotation of ventricular EGMs	Number of EGMs	LPM algorithm (correct/ unrecognized / artifact)	Wavefront algorithm (correct/ unrecognized / artifact)
Overall accuracy	77,259	**94.5%** / 4.0% / 1.5%	**83.7%** / 16.1% / 0.2%
Abnormal EGMs	68,939	94.1% / 4.6% / 1.3%	81.4%/ 18.4% / 0.2%
LAVAs	16,316	**81.1%** / 18.7% / 0.2%	**23.9%** / 76.1% / 0%
Definite LAVAs	9,319	**84.6%** / 15.3% / 0.1%	**17.1%** / 82.9% / 0%
Intra far-field LAVAs	6,997	76.4% / 23.5% / 0.1%	32.8% / 67.2% / 0%

3 LOCAL CONDUCTION VELOCITY ANALYSIS

LCV analysis identified a median of 2 intra-scar conduction corridors per patient (IQR: 2-3), including the one acting as VT isthmus in all cases.







Conclusions

- LPM algorithm provides a reliable automatic annotation of the complex ventricular EGMs.
- LCV analysis represents a new step forward in substrate characterization, moving from timing and voltage assessment towards the functional evaluation of conduction velocity properties.
- LVC analysis allows a less operator-dependent identification of steep conduction slowing sites and improves recognition of intra-scar conduction corridors acting as VT isthmuses.