Optimization of a Novel Activation-Repolarization Metric to Identify Targets for Catheter Ablation

Fernando O. Campos*, Michele Orini, Ben Hanson, Pier Lambiase, Bradley Porter, Christopher Aldo Rinaldi, Jaswinder Gill, Peter Taggart and Martin J. Bishop

School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom

Background: Identification of targets for catheter ablation of arrhythmias remains a significant challenge. We have recently developed a novel substrate mapping procedure, termed the Reentry Vulnerability Index (RVI), which incorporates both activation (AT) and repolarisation (RT) times to identify ablation targets. Despite showing promise in a series of experiments, the approach requires further development to enable its incorporation into a clinical protocol.

Objective: To use computer simulations to optimize the RVI procedure for its future usage within the clinic.

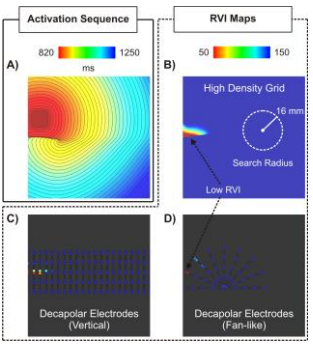

Figure 1: Simulation results on a 2D model. A) ATs of a premature stimulation (t = 820 ms) following two paced beats at 2 Hz. B) RVI map computed on the high-density grid. C) and D) RVI maps computed according to different positions of a decapolar electrode.

Methods: A 2D computational model was employed to investigate the behavior of the RVI algorithm under mapping catheters recordings resembling clinical conditions. Conduction block following premature stimulation (Fig. 1A) was induced and mapped in a cardiac tissue model including repolarization heterogeneity reported in infarcted hearts. RVI maps were computed based on the difference between RTs and ATs between successive pairs of electrodes within a given search radius. A color map is then constructed to highlight small RVI values which identify vulnerable sites for reentry (Fig. 1B).

Results: Within 2D sheet models we show that RVI maps computed on sparse recording sites randomly placed on the tissue surface were in good agreement with high resolution maps. Moreover, RVI maps computed on recording sites resembling a decapolar electrode placed linearly as well as on a fan-like arrangement also captured regions of small RVIs (see Fig. 1C-D).

Conclusion: The RVI algorithm performed well under a wide range of clinically-relevant mapping conditions. The RVI metric was capable of indentifying pro-arrhythmic regions which may be used to guide ablation.