Scar Imaging Minimally Affects Ablation Target Identification with In-silico Pace-mapping

Fernando O. Campos, Pranav Bhagirath, Sofia Monaci, Zhong Cheng, John Whitaker, Gernot Plank, C. Aldo Rinaldi and Martin J. Bishop

King's College London
London, UK

Background: In-silico pace-mapping relies on an anatomically-tailored computational model and the patient's ECG to create a 'virtual' pace map for ablation therapy of ventricular tachycardia (VT). However, its effectiveness hinges on accurately constructing the scar within the model, a process potentially constrained by the quality of cardiac MR (CMR) data.

Objective: to investigate the impact of scar imaging quality on the efficacy of in-silico pace-mapping in pinpointing VT origin.

Methods: VTs were simulated in 15 patient-specific heart models reconstructed from high-resolution (1mm isotropic) contrast-enhanced CMR. VT circuits were visually assessed to identify exit sites (ground truth) in each case (Fig A). Scar anatomy was modified to represent three imaging resolution levels: high-res scar (default), low-res scar #1 (standard clinical CMR sequences), and low-res #2 (overestimated scar volume). The ECG of each simulated VT served as input for in-silico pace-mapping, involving pacing the heart at N=1000 random sites near the infarct (< 5mm). Simulated ECGs were correlated with VT ECGs to construct virtual pace maps, and the distance (d) between the VT exit site and the pacing location with the strongest correlation was calculated.

Results: The correlation between VT and paced ECGs was similar in distribution in the high- and low-resolution scar models #2 (Fig B). Although overall the performance of the in-silico pace-mapping was highest in high-res scar models (d=9±5.6mm), low-res #1 and #2 still adequately located exit sites (d=9±6.4mm and d = 15.4±13.1mm, respectively) (Fig C).

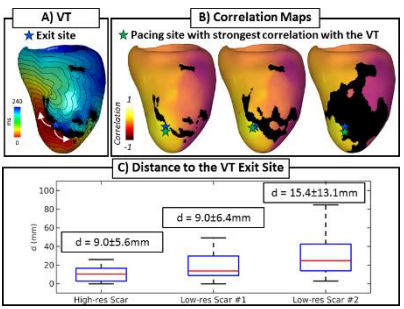

Figure: Scar models and Results

Conclusion: In-silico pace mapping provides a robust method of pre-procedural planning to identify VT ablation targets that is relatively insensitive to image resolution used for model construction.