Utility of In-silico Pace Mapping to Successfully Identify Simulated Ventricular Tachycardia Exit Sites Non-Invasively Using both 12-lead ECG Recordings and Electrograms from Implanted Devices

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Pace-mapping is a time-consuming and invasive procedure for localizing optimal ablation sites – exit sites or isthmuses, requiring an existing ventricular tachycardia (VT)-ECG recording. Patient-specific computational models have the potential to perform non-invasive pace-maps to be used in pre-procedural planning with the ability to explore alternative (existing) VT signals (e.g. implanted devices electrograms - EGMs), different pacing protocol (epicardial, endocardial, transmural), and test recently proposed techniques (e.g. reference-less pace mapping). Using a 3D computational torso model (A) we simulated six different monomorphic VT episodes in the presence of three different infarct anatomies and performed in-silico pace-mapping. VT exit sites were successfully localized by comparing paced QRS complexes and simulated VT QRSs, and EGMs (B) from an implanted device (C and D). In addition, we performed reference-less pace-mapping, which compares QRSs and EGMs between different pacing locations, returning useful information on isthmuses. Finally, we saw a decrease in accuracy of performance of EGM pace mapping during epicardial pacing, due to the prevalence of endocardial sensing leads.

In conclusion, our study showed the possibility of substituting ECG pace mapping with EGM pace-mapping, which allows quicker pre-planning, as VT induction is not required, and more accurate ablation procedures, avoiding the mismatch between EP-induced and clinical VTs.