Unraveling the Influence of Right Ventricle Presence on Paced ECGs

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Background: In-silico pace-mapping employs a personalized anatomical computational model alongside the patient's ECG to produce a 'virtual' pace map, facilitating its application in ablation therapy for ventricular arrhythmias (VTs). Due to challenges in accurately defining the boundaries of the right ventricle (RV) wall with standard scan resolutions and infarct scars being predominantly found in the left ventricle (LV) myocardium, many computational studies focus solely on modeling the left ventricle (LV) anatomy. However, the impact of the RV's presence or absence on the ECG during pacing remains unexplored.

Objective: To compare ECGs derived from pacing in the presence and absence of the RV.

Methods: N=20 personalized biventricular (BiV) computational models were created from CT data. An LV version of each BiV model was derived by isolating the LV submesh. Stimuli were delivered at 17 locations within the LV, corresponding to each AHA segment (Fig A). Simulated ECGs resulting from pacing each AHA segment in the BiV were correlated with ECGs from pacing the LV model in the respective segment. The average of the top 10 coefficients across all 12 ECG leads (ccm10) was then computed.

Results: Figs B-C depict activation maps and simulated ECGs within both BiV and LV models of a representative patient after pacing at segment 7. The ccm10 in this case was 0.98. The mean ccm10 per AHA segment across all models is illustrated in Fig D, with the lowest and highest mean values observed in segments 8 (0.92) and 15 (0.99), respectively.

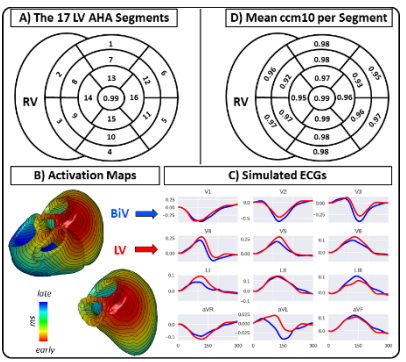

Figure: Results

Conclusion: In-silico experiments showed that while paced ECGs in BiV and LV only models can differ in shape and amplitude, they are still strongly correlated (ccm10 > 0.90). This finding suggests that the RV may not be necessary in applications using simple pacing such as in-silico pace-mapping.