Non-invasive Predicted Electrical and Measured Mechanical Indices Predict Response to Cardiac Resynchronization Therapy

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Background: Sub-optimal placement of the pacing lead can cause non-response in cardiac resynchronization therapy (CRT) patients. Acute hemodynamic response (AHR) measurement is currently used to identify optimal lead locations. However, it is invasive and associated with increased procedure times and risks.

Methods: The AHR was measured at 5 potential LV epicardial pacing sites in 26 CRT patients (on average 3 sites per patient). Positive patient response was defined as AHR≥10%. CT images were used to personalize the geometry and the electrical properties of heart models for each patient. We simulated the electrical activation of the ventricles, tracked the cardiac motion, and measured the LV wall thickness at each pacing site.

Results: We tested the ability of the simulated electrical (LV delay), measured mechanical (time to 10% contraction), and anatomical (wall thickness) indices to predict positive response (AHR≥10%). Areas under the ROC curves were 0.73 (electrical LV delay), 0.65 (mechanical time to 10%), and 0.47 (anatomical wall thickness) for the different indices. We were able to predict positive response with relative LV delay≥ 60% ($p<0.01$) and time to 10% contraction≥15% ($p<0.05$). LV wall thickness measurements were not predictive.

Conclusion: Non-invasive electrical and mechanical indices can predict optimal epicardial lead location. Prospective analysis of these indices could allow clinicians to test the AHR at targeted pacing sites and reduce time, costs and risks of the procedure.

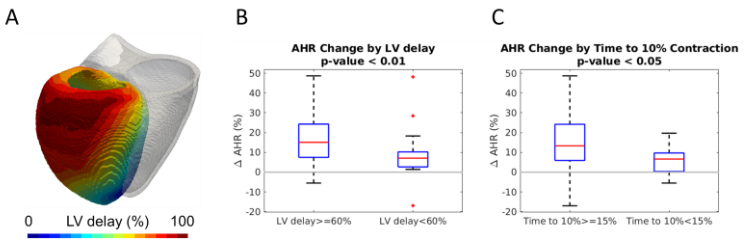

Figure 1: A) The electrical activation with RV pacing was simulated for each patient case and the relative LV delay was calculate. Positive responses could be predicted with B) electrical (relative LV delay>60%) and C) mechanical (time to 10% contraction) measures