His Bundle and Left Bundle Pacing with Optimized Atrio-ventricular Delay Achieve Superior Electrical Synchrony over Endocardial and Epicardial Pacing in Left Bundle Branch Block Patients

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Description: Heart failure is a progressive and prevalent disease. In some heart failure patients, the organised electrical activation of the heart breaks down. In these patients, pacing leads can be placed on the heart to return the heart to a synchronous, efficient and effective activity pattern.

Conduction system pacing (CSP), either delivered through His bundle (HBP) or left bundle pacing (LBP) is emerging as a novel method to deliver cardiac resynchronization therapy (CRT) and return the heart to a synchronous activation. We used computational electrophysiology models to compare different CRT delivery methods in a virtual cohort of left bundle branch block (LBBB) patients.

For each patient model, we included a His-Purkinje system with LBBB that predicted activation time across the heart and an ECG (Fig. 1). We simulated epicardial and endocardial biventricular pacing, HBP and LBP with and without optimised atrioventricular (AV) delay (Fig. 2). We found that HBP was more effective at reducing ventricular activation times compared to biventricular epicardial and endocardial pacing, while LBP without AV delay optimization was less effective than HBP due to delayed right ventricular (RV) activation. When LBP was delivered with optimized AV delay, the patient's intrinsic activation travelled down through the right bundle to the RV, leading to faster RV activation and comparable synchrony to HBP.

Our results provide a mechanistic explanation of why optimised AV delay improves response to LBP, laying the foundation for future clinical trials investigating CSP.

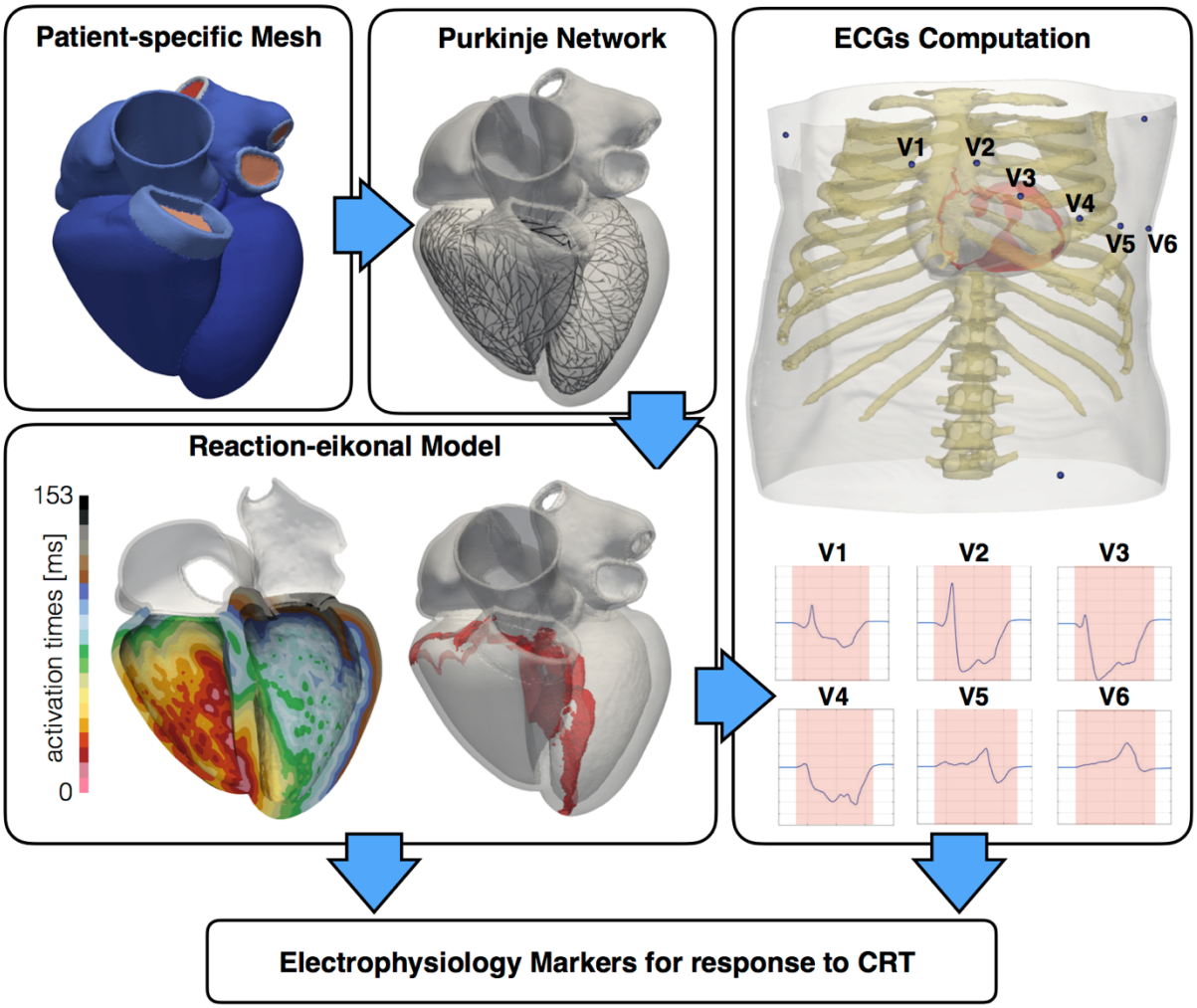

Figure 1: ***Electrophysiology simulation pipeline.*** *We added a His-Purkinje system to each mesh, simulated ventricular activation with a reaction-eikonal model and computed 12-lead ECGs to compute QRS duration.* ***Abbreviations:*** *electrocardiograms (ECGs), cardiac resynchronisation therapy (CRT).*

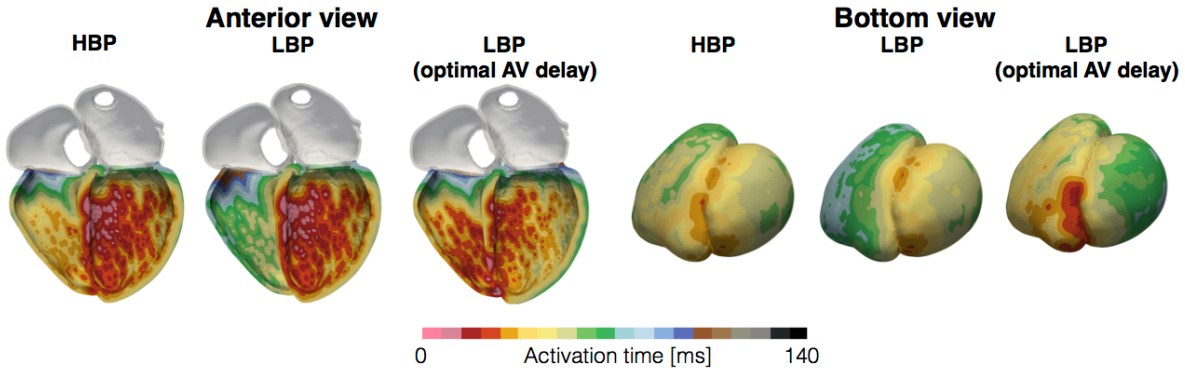

Figure 2 ***Response to LBP with optimised AV delay*** *Simulated activation times with HBP, LBP without AV delay optimization and with AV delay optimization. With AV delay optimization, the RV activation times are shorter compared to LBP without AV delay optimization, improving overall ventricular synchrony.*

Figure 3: Role of those included in the picture

Weblink: https://www.heartrhythmjournal.com/article/S1547-5271(20)30627-5/fulltext

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Prizes

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