Left Bundle Branch Area Pacing Generates More Physiological Ventricular Activation Sequences than Right Ventricular Pacing

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Left bundle branch area pacing (LBBAP) has been proposed as a new physiological pacing modality to overcome ventricular dyssynchrony (VD) reported in bradycardic patients undergoing conventional right ventricular pacing (RVP). VD may result in left ventricular dysfunction and lead to atrial fibrillation and heart failure. The standard non-invasive measure of depolarization synchrony is the QRS duration. However, a deeper understanding of not only the activation time but also the activation sequence is needed to evaluate the effects of RVP and LBBAP in the highly heterogeneous population of bradycardic patients. This study aimed to estimate the precordial ventricular activation from standard 12-lead ECGs of bradycardic patients with narrow QRS (physiological conduction) and right bundle branch block (RBBB, disturbed conduction) and use it to compare LBBAP vs RVP.

37 RVP and 62 LBBAP ECGs recordings were collected before and after pacemaker implantation. Two frequency-based analyses of the QRS complex were performed using high-frequency (HF) and low-frequency (LF) bands in the 150-450 Hz and 10-60 Hz ranges, respectively. Precordial activation sequences and the precordial activation delays (pADs) were estimated.

For both frequency analyses, results showed LBBAP did not significantly affect the activation sequence in patients with narrow QRS at baseline and it reduced VD in RBBB patients. The pAD values were significantly lower after LBBAP than after RVP in narrow QRS [HF: -7(-18,6) vs 29(6,56); LF: 9(-25,13) vs 31(17,38) ms, p<0.01] and RBBB patients [HF: -16(-22,-10) vs 20(10,51); LF: -22(-42,-18) vs 39(31,61) ms, p<0.01]. The activation sequences following RVP showed considerable delay in V6, supporting RVP-induced left ventricular delay in both patient populations.

The proposed HF and LF analyses suggest that LBBAP leads to higher activation synchronization than RVP in bradycardic patients pacemaker indicated. LF analysis could be used in clinical practice to identify more physiological pacing sites from standard 12-lead ECGs.

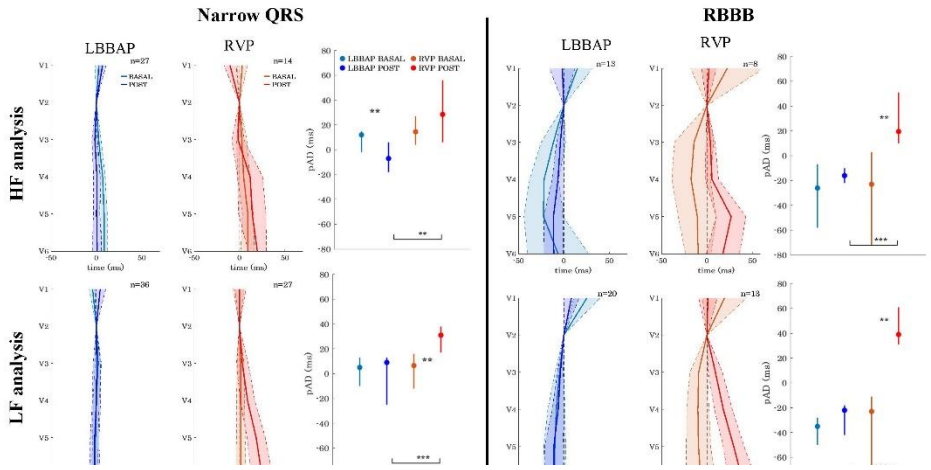

*Figure 1: Mean and 95% confidence interval of activation sequences and median and 95% confidence interval of pAD for each group of LBBAP and RVP at baseline and at post-implantation state for HF an LF analysis. **P-value<0.01, ***P-value<0.001*