Impact of CRT Device Settings on Interventricular Dyssynchrony: An Analysis Using Non-Invasive Activation Map Reconstruction

Svyatoslav Khamzin[1], Stepan Zubarev[1], Anastasiia Bazhutina[1], Margarita Budanova[1], Aleksandr Sinitca[1], Mikhail Chmelevsky[1,2]

[1]XSpline S.p.A, Bolzano, Italy
[2]Division of Cardiology, Fondazione Cardiocentro Ticino, Lugano, Switzerland

Aim. Reconstruction of realistic cardiac ventricular activation maps is crucial for adjusting Cardiac Resynchronization Therapy (CRT) device settings. Building upon our previously developed algorithm for non-invasive reconstruction of cardiac activation maps using 12-lead electrocardiogram (ECG) and computed tomography data, we focused on applying this method to develop an innovative approach for analyzing CRT device settings and their impact on interventricular dyssynchrony characteristics.

Methods. Our methodology involved utilizing the reconstructed Left Bundle Branch Block (LBBB) activation map to derive parameters for computational models subsequently using it for the simulation of various biventricular pacing modes of CRT devices. Using data from 5 patients with previously recorded LBBB and implanted CRT we investigated the effects of different device settings and corresponding ECGs on dyssynchrony characteristics in order to discern optimal configurations of pacing modes for patient-specific treatment. To validate the resulting activation maps, we compared patient ECGs with different device settings and simulated ECGs. For validation we are used Spearman correlation coefficient between measured patient ECG signal and calculated one.

Results. Our results showed that QRS duration often does not lead to optimal ventricular dyssynchrony. The optimal delay between the left and right electrodes, using the intraventricular dyssynchrony index, depended on LV lead localization. The mean Spearman correlation coefficient between the patient's ECG during biventricular pacing and the simulated ECG was **0.73** (+ - 0.13).

Conclusion. This preliminary study evaluated the feasibility of using non-invasive mapping based on forward ECG problem solving to optimize the parameters of the CRT device. Our findings indicated that the ECGs calculated at different device parameters showed a high correlation and could be used to effectively adjust the CRT device parameters.