The Use of Autocorrelation Maps for Evaluation of Cardiac Resynchronization Therapy Outcome

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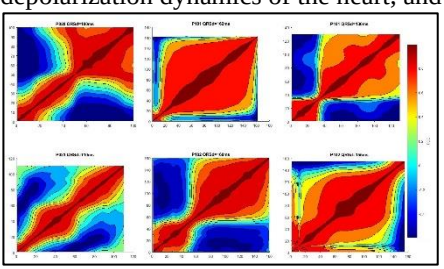
Cardiac resynchronization therapy (CRT) is one of the newest treatment technologies of the failing hearts, however the parameters predicting and characterizing the success of the therapy are still searched.

Body surface potential maps (BSPMs) from 128 electrodes on the torso were measured on 14 healthy subjects and two patients undergoing CRT. One patient had left bundle branch block and positively responded to the therapy (P101), the second patient had right bundle branch block together with left anterior hemiblock and was a non-responder (P102). BSPMs for both patients were measured for their spontaneous heart rhythm and five stimulation protocols, one of which was optimized for their CRT. For all BSPM measurements we computed autocorrelation maps (ACMs) using Pearson's correlation coefficients (PCC) from corresponding BSPMs for each couple of time instants during the depolarization time interval.

Visual observation revealed a typical pattern in ACMs for healthy heart depolarization. Interestingly, we observed similar ACM pattern for spontaneous rhythm of the non-responder but a considerably different pattern in ACM of spontaneous rhythm for the responder. After application of the CRT stimulation protocol, the ACM of the responder became more similar to the ACMs of healthy depolarization what was not the case of the non-responder. To quantify the ACMs properties, we suggested ten parameters characterizing various proportions (in %) of the values in ACMs: <–1.0,-0.25), <–1.0,-0.4), <–0.4,0.4>, <–1.0,0.0), (0.25,1.0>, (0.4,1.0>, (0.7,1.0>, (0.8,1.0>, (0.9,1.0>, (0.995,1.0>. According to the Wilcoxon rank-sum test at the 5% significance level about equality of distributions for the healthy and failing hearts, nine of them were significantly different.

From the obtained results even on the (up to date) very limited number of the CRT patients we hypothesize that ACMs can be used for evaluation of the depolarization dynamics of the heart, and prediction of the CRT outcome.



ACMs for healthy and failing hearts. Right column – healthy hearts. Middle – spontaneous QRS of failing hearts (upper responder, lower non-responder), Left – CRT of failing hearts (upper responder, lower non-responder)