

Synchronization of repolarization after cardiac resynchronization therapy: a combined clinical and modeling study

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Abstract

Background: The changes in ventricular repolarization after cardiac resynchronization therapy (CRT) are poorly understood. *Objective:* Address this knowledge gap using a multimodality approach including electrocardiographic and echocardiographic measurements in patients and using patient-specific computational modeling. *Methods:* In 33 patients electrocardiographic and echocardiographic measurements were performed before and at various intervals after CRT, both during CRT-ON and temporary CRT-OFF. T-wave area was calculated from vectorcardiograms, reconstructed from the 12-lead ECG. Computer simulations were performed using a patient-specific eikonal model of cardiac activation with spatially varying action potential duration (APD) and repolarization rate, fit to a patient's ECG. *Results:* During CRT-ON T-wave area diminished within a day and remained stable thereafter, whereas QT-interval did not change significantly. During CRT-OFF T-wave area doubled within 5 days of CRT, while QT-interval and peak-to-end T-wave interval hardly changed. Left ventricular (LV) ejection fraction did not significantly increase before 1 month of CRT. Computer simulations indicated that the increase in T-wave area during CRT-OFF can be explained by changes in APD following chronic CRT that are opposite to the change in CRT-induced activation time. These APD changes were associated with a reduction in LV dispersion in repolarization during chronic CRT. *Conclusions:* T-wave area during CRT-OFF is a sensitive marker for adaptations in ventricular repolarization during chronic CRT that may include a reduction in LV dispersion of repolarization.

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