Correct the left ventricular dyssynchrony, correct the rocking

Victoria Delgado*

Department of Cardiology, Heart and Lung Center, Leiden University Medical Center, Albinusdreef 2 2300 RC, Leiden, The Netherlands

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The presence of left ventricular (LV) dyssynchrony in heart failure patients has been largely associated with improved outcome and LV reverse remodelling after cardiac resynchronization therapy (CRT). However, definition of LV dyssynchrony remains controversial. While current guidelines include QRS duration (>120 ms) and morphology [left bundle branch block (LBBB) vs. non-LBBB] as marker of LV dyssynchrony, it has been demonstrated that these electrocardiographic parameters do not accurately reflect the amount of LV mechanical dyssynchrony. Left bundle branch block morphology and QRS >140 ms have been associated with high likelihood of response to CRT. However, still 30% of patients do not show response. Imaging techniques have provided numerous parameters to characterize LV dyssynchrony. Nevertheless, the only non-randomized study evaluating the accuracy of echocardiographic parameters to predict response to CRT, the Predictors of Response to Cardiac Resynchronization Therapy (PROSPECT) trial, showed modest performance of a dozen of echocardiographic parameters of LV dyssynchrony. Advances in three-dimensional (3D) imaging techniques and strain analysis have permitted characterization of LV mechanics and synchronicity more precisely by providing information of mechanical activation pattern for the entire ventricle and measures that reflect the presence of transmural scar, an important pathophysiological determinant of CRT response. Electromechanical models that integrate electrical activation delay, regional differences in LV contractility, and myocardial scar have been developed permitting simulation of different myocardial substrates of LV dyssynchrony. Lumens et al. investigated the effect of CRT on different models of LV dyssynchrony (in isolation or combination): the electromechanical substrate mimicking the LBBB activation pattern, the non-electrical hypocontractility substrate caused by increasing grades of contractility decrease in the LV posterolateral region, and the non-electrical scar substrate where increasing grades of LV stiffness are added to the various grades of regional hypocontractility mimicking transmural scar. The systolic stretch index was the LV dyssynchrony index derived from these models which is calculated as the sum of the posterolateral systolic pre-stretch and the septal systolic rebound stretch. The authors observed that a larger systolic stretch index caused by a pure electromechanical substrate was associated with acute hemodynamic improvements after CRT, whereas the systolic stretch index caused by non-electromechanical substrates was rather small and was not associated with such haemodynamic improvements. Based on these results, imaging techniques should focus on the development of indices that characterize myocardial substrates of LV dyssynchrony that can be corrected by CRT, since correction of LV dyssynchrony has been demonstrated to be associated with better outcome, whereas worsening of LV dyssynchrony has been associated with worse outcome. How to identify in routine clinical practice myocardial substrates of LV dyssynchrony that can be corrected with CRT?

Three-dimensional imaging techniques and electroanatomical models are not widely available and demand high expertise. Using a hieroglyphic framework, Sweeney et al. identified among patients with heart failure and LBBB QRS configuration the electrocardiogram features that are associated with response to CRT: a longer LV activation time (difference between the QRS duration and the right ventricular activation time) and smaller Selvester QRS score (indicating myocardial scar burden). However, this analysis has important limitations, and current imaging techniques depict more accurately than QRS scores the amount of myocardial scar. In the current issue of this Journal, data from the PREDICT-CRT multicentre observational study highlight the value of assessment of LV apical rocking and septal flash and their correction after CRT implantation to predict response to CRT and outcome. A total of 1060 heart failure patients treated with CRT were included (88% with LBBB configuration). Left ventricular apical rocking was defined as a short septal motion of the apex due to the contraction of the septum early in systole and a subsequent long motion to the lateral side during ejection due to the late lateral contraction caused by the LBBB activation pattern. Stankovic et al. demonstrated that 64% of patients exhibited LV apical rocking and 63% septal flash. Response to CRT (based on LV reverse remodelling) was observed in 69% of patients with isolated LV apical rocking, 56% of patients with isolated septal flash, and 77% of patients presenting with both LV apical rocking and septal flash. Correction of LV apical rocking by CRT was observed in 55% of patients and was associated with higher frequency...
of LV reverse remodelling and better outcomes. However, it remains unknown how much of the LV dyssynchrony myocardial substrate is represented by LV apical rocking. As shown previously, it may merely reflect the abnormal LV contraction pattern caused by LBBB, and the magnitude of LV apical rocking may be influenced by other factors such as extent of myocardial scar. In addition, it remains unknown how this myocardial substrate of LV dyssynchrony may respond to the different positions of the LV pacing lead and how other factors may influence on its response and the impact on outcome (percentage of biventricular pacing, atrial fibrillation, or associated co-morbidities). The present large registry ongoing research to define by means of imaging the LV dyssynchrony substrates that can be corrected by CRT. However, how novel indices of LV dyssynchrony will be incorporated in guidelines remains unknown.

To date, LV dyssynchrony assessment with echocardiography has been used to select heart failure patients for CRT in few randomized clinical trials. The large body of evidence showing the benefits of CRT in patients in sinus rhythm with LBBB configuration and QRS > 150 ms supports the use of this therapy without the addition of imaging techniques to assess LV dyssynchrony. However, there are subgroups of patients (non-LBBB morphology, QRS duration between 120 and 150 ms or ischaemic aetiology) in whom a thorough evaluation of the LV dyssynchrony myocardial substrate may help to optimize the results of this therapy and identify the patients who will not benefit from CRT.

References