Importance of left ventricular lead position in cardiac resynchronization therapy

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This editorial refers to ‘Impact of left ventricular lead position in cardiac resynchronization therapy on left ventricular remodelling. A circumferential strain analysis based on 2D echocardiography’† by M. Becker et al., on page 1211

At present, cardiac resynchronization therapy (CRT) is considered a major breakthrough in the treatment of patients with drug-refractory heart failure. The startling benefits of CRT observed in small initial studies have now been clearly confirmed in large randomized controlled multicentre trials which have now included over 4000 patients.1,2 The beneficial effects of CRT observed in these trials include an improvement in clinical symptoms as well as an improvement in left ventricular (LV) haemodynamics and a reduction in LV volumes. In addition, CRT resulted in a dramatic reduction in heart failure related hospitalizations and a reduction in all-cause mortality. On the basis of these impressive results, CRT is now considered a class I (level of evidence A) indication in both the European (ESC) and the American guidelines (ACC/AHA/HRS) in heart failure patients with the following characteristics: NYHA classes III–IV, a QRS duration of >120 ms, and an LV ejection fraction <35%.

However, in parallel to the impressive results, it became clear that the extent of benefit following CRT was highly variable among patients when the traditional selection criteria (NYHA classes III–IV, QRS duration >120 ms, and LV ejection fraction <35%) were applied.1 The majority of patients experienced a dramatic improvement in clinical symptoms following CRT implantation, but some patients improved to a lesser extent, whereas a consistent number of ~30% failed to improve or even worsened in heart failure symptoms. In addition, when response to CRT was defined using more objective parameters such as LV reverse remodelling or improvement in LV ejection fraction, the number of non-responders is usually between 40 and 50%.3 In view of the unnecessary procedure risks and health care expenditure, most of the current research in the field of CRT is focused on identification of non-responders.

Several recent studies have now indicated that the key mechanism of response following CRT is related to resynchronization of pre-existent LV dyssynchrony.3–5

Since this observation, several cardiac imaging techniques have been tested for their ability to detect and quantify LV dyssynchrony.3–5 Among the different techniques, echocardiography proved particularly well suited for detection of LV dyssynchrony in the clinical setting. One of the most widely studied techniques is colour-coded tissue Doppler imaging.3,4 Although the echocardiographic detection of pre-existing LV dyssynchrony has been identified as the key factor for response to CRT, the search for other factors related to response has continued.

One other important issue related to (the extent) of response following CRT is the position of the LV pacing lead. At present, the LV pacing lead is preferably positioned in one of the (postero-)lateral branches of the coronary sinus. Rossillo et al.6 indicated the importance of LV lead positioning in a retrospective analysis of 233 patients undergoing CRT implantation. The authors demonstrated a clear improvement in LV ejection fraction in patients with a (postero-)lateral LV lead position, whereas LV ejection fraction remained unchanged in patients with an anterior/antero-lateral LV lead position.6

More recently, Suffoletto et al.7 demonstrated that patients with a match between the LV pacing lead and the site of latest LV mechanical activation had a larger increase in LV ejection fraction at mid-term follow-up when compared with patients with a mismatch between LV lead position and site of latest activation (10 ± 5 vs. 6 ± 5%, P < 0.05). The authors used echocardiography with 2D strain to assess the area of latest mechanical activation, but the LV was divided into only six segments.7 Murphy et al.8 used a more sophisticated approach with a 12-segment model (six mid and six basal segments) and 3D tissue synchronization imaging. The authors demonstrated that the largest reduction in LV end-systolic volume (indicating reverse LV remodelling) occurred in patients with a match between the LV lead position and the site of latest mechanical activation.8

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Becker et al. have addressed the issue of LV lead positioning in 47 patients undergoing CRT. The authors have used echocardiography with 2D strain imaging (speckle tracking) to assess the site of latest mechanical activation (using 17 LV segments). At 10 months follow-up, the benefit of CRT was more outspoken in patients with optimal (n = 28) vs. non-optimal LV lead positioning (n = 19) with a larger increase in LV ejection fraction (12 ± 3 vs. 7 ± 4%, P < 0.001), a larger decrease in LV end-systolic volume (42 ± 10 vs. 27 ± 8 mL, P < 0.001) and a larger increase in VO2max. In addition, the distance between the segment with the latest systolic strain prior to CRT and the LV lead position was the only independent predictor of improvement in LV volumes at 10 months follow-up. These echocardiographic studies strongly support an echo-guided positioning of the LV pacing lead (determining the site of latest mechanical activation) to optimize benefit from CRT.

As indicated by Becker et al., one of the current draw-backs of this approach is the fact that the echocardiographic analysis requires experience and is time-consuming. However, (semi-)automated software packages will be developed to simplify the analysis of the data.

Another potential drawback for patient-tailored LV lead positioning is the limited number of (suitable) branches of the coronary sinus, and a mismatch may exist between the area of latest mechanical activation on echocardiography and the venous anatomy. This problem may potentially be overcome by epicardial LV lead placement via a minimally invasive surgical approach. In this respect, it may be preferred to have information on venous anatomy before CRT implantation to decide on a surgical or transvenous approach for LV lead positioning. With the current 64-slice MSCT scanners, it is possible to depict with high accuracy the venous anatomy. Ideally, one could thus integrate the information from echocardiography (latest mechanical activation) and from MSCT (venous anatomy) to determine which approach is preferred. It is anticipated that non-invasive imaging may guide LV lead positioning to further optimize response to CRT.

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References