The use of real-time three-dimensional echocardiography (RT3DE) for cardiac resynchronization therapy (CRT) is significantly increased in the last years, with several applications. In this brief report on RT3DE and CRT, the highlights of scientific abstracts of the European Society of Cardiology (ESC) meeting 2008 (Munich, 30 August – 3 September) have been summarized by Nina Ajmone Marsan, MD.

**Use of RT3DE to assess left ventricular dyssynchrony**

The results of PROSPECT trial recently suggested that tissue Doppler imaging and conventional echocardiographic measures have limited additional value over the standard inclusion criteria of the guidelines for prediction of response to CRT, mainly due to a high inter-laboratory variability. However, novel techniques, such as 2D strain imaging and RT3DE, were not included in this trial and may provide complete and accurate information on left ventricular (LV) dyssynchrony. In particular, RT3DE has several potential advantages: 1) in 1 single acquisition, it takes the whole LV into account (16/17 segments) without any limit due to angle-dependency; 2) it measures LV regional volumetric changes during the cardiac cycle, as a composite effect of longitudinal, radial and circumferential contraction and 3) using a semi-automated algorithm to measure LV dyssynchrony, it seems highly reproducible.

A small substudy of the PROSPECT trial (22 patients) was presented at ESC Congress 2008 and it tested the value of RT3DE to predict response to CRT (1). In particular, the following parameters were included in the analysis: 1) mean time to minimum systolic volume (mean 3D-Tmsv); 2) standard deviation of 16 segment time to minimum systolic volume indexed with the RR interval (SDI) and 3) maximum intersegmental delay (time difference between the earliest and the most delayed contracting segment) (Δt max). Favorable response to CRT was defined as a reduction ≥15% in LV end-systolic volume. ROC curve analysis revealed that these parameters could predict response to CRT (p <0.05) with a cut-off value of 200 ms for Δt max, 390 ms for mean 3D-Tmsv and 6.0% for SDI. However more important, the mean 3D-Tmsv showed the best combination of sensitivity (86%) and specificity (75%) whereas the others showed a high sensitivity (93%) with lower specificity (50%).

The predictive value of RT3DE for response to CRT was also explored in a single-center study (2). A total of 51 heart failure patients were included and, as in the abovementioned study, response to CRT was defined as a reduction ≥15% in LV end-systolic volume 6 months after CRT implantation. LV dyssynchrony was measured using the systolic dyssynchrony index (SDI). At follow-up, 34 (67%) patients were classified as responders. Baseline clinical and echocardiographic characteristics were similar between responders and non-responders, except for the SDI, which was larger in responders (9.7±3.6% vs. 3.4±1.8%, p <0.001). ROC curve analysis revealed that a cut-off value for SDI of 6.4% yielded a sensitivity of 88% and a specificity of 85% to predict echocardiographic response to CRT.
In conclusion, the preliminary results of both these studies suggest that RT3DE may provide accurate measures of LV dyssynchrony and may be a good predictor of response to CRT.

Use of RT3DE to assess left ventricular function

Several studies demonstrated that RT3DE is more accurate than 2D echocardiography and comparable to magnetic resonance imaging to quantify LV volumes and ejection fraction. For the evaluation of potential candidates to CRT, assessment of LV ejection fraction is crucial and, after implantation, quantification of LV end-systolic volume is probably the most clinically meaningful marker of therapy success. Therefore, RT3DE may be the method of choice for an accurate estimate of LV volumes and function, overcoming the drawbacks of geometric assumptions and cut-plane reproducibility in sequential studies. Furthermore, RT3DE, in the same acquisition and analysis, integrates this information with a quantitative analysis of LV dyssynchrony.

Two studies presented at ESC Congress 2008 (3,4), confirmed the accuracy of RT3DE for LV volumes assessment in a comparison with magnetic resonance imaging, including 130 and 139 patients, respectively, with ischemic cardiomyopathy. Furthermore, the authors demonstrated that RT3DE may be used to characterize LV morphology and, in particular, for a more accurate measure of sphericity index.

In addition, Ajmone Marsan et al. (2) showed that RT3DE allows for the assessment of the effect of CRT on Left Atrium (LA) size and function. The changes in LA volumes and function may be of great interest in heart failure patients, since these parameters are well known predictors of adverse cardiovascular outcomes. In this study, patients who showed a favourable response to CRT in terms of LV remodeling also demonstrated a significant LA reverse remodeling (LA max volume decreased from 38±21 ml/m² to 32±16 ml/m², p <0.01) and an improvement in LA conduit and reservoir function. The LA active contraction did not significantly improve due to pre-selection of the patients in sinus rhythm.

References


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