The role of echocardiography in patient selection for CRT: the switch from motion to understanding regional ventricular function

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During the last decade, since its introduction, cardiac resynchronisation therapy (CRT) has become a mainstay therapy in a selected group of patients with end-stage heart failure and a left bundle branch block (LBBB) on the ECG. While the evidence for the beneficial effects of CRT in large populations has been established unequivocally,¹ it is the response in the individual which has grasped the interest of most due to the relatively large number of nonresponders. In up to 40% of patients fulfilling the current guideline criteria for CRT no clinical improvement and/or echocardiographical remodelling is observed during follow-up. Many studies have been conducted to distinguish the responders from the nonresponders in order to improve the selection of patients who would benefit from this relatively expensive treatment.

The observation of asynchronous contraction in patients on echocardiography has been the main focus to improve patient selection. The conduction disorder within the left ventricle resulting from an LBBB in heart failure patients often manifests as mechanical dyssynchrony, subjectively described as apical rocking or asynchronous contraction. The real challenge, however, seems to be the quantification of this mechanical dyssynchrony.² A multitude of echocardiographic parameters have been proposed to identify patients with either mechanical dyssynchrony amendable to CRT or the nonresponders without this dyssynchrony. The most promising technique has been the measurement of

peak systolic velocities by tissue Doppler imaging (TDI) throughout the LV to assess regional differences in timing of contraction. Unfortunately this technique seems to be hampered by both practical (identification of the peak velocity) and conceptual limitations.² Consequentially these parameters did not pass the stress test of the 'randomised clinical trial'. Both the PROSPECT³ and RETHINQ⁴ trials have clearly indicated that using only the timing of peak upward velocities has no added value in patient selection on top of the current guidelines. Since then the echocardiographic assessment of ventricular dyssynchrony has moved from regional motion (velocities) towards regional function by deformation imaging⁵ and 3D echocardiography.⁶

In this issue, Scheffer et al. have compared the difference between TDI-derived velocity and deformation in predicting response to CRT, defined as an improvement in NYHA functional class.⁷ This was evaluated in a retrospective study design in which a total of 83 patients fulfilling the current criteria for CRT implantation, with nonischaemic cardiomyopathy, and with satisfactory echocardiographic images, were analysed. Their main finding was that a septal to lateral delay in peak longitudinal shortening of >60 msec is superior to the septal to lateral delay in peak systolic velocities. The presence of this delay before CRT implantation predicted an improvement in NYHA functional class, dP/dt, and most conventional echocardiographic parameters. Interestingly, this delay by deformation imaging was significantly reduced in the responders at follow-up while peak velocity showed very conflicting findings. The main limitation of the velocity measurement seems to be the reproducibility, which was almost negligible for strain due to the easy identification of the peak deformation value. Even though these results are very promising, there are some important limitations to this study. The study design was retrospective and unblinded. In addition, there is an unknown number of excluded individuals, which

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questions the feasibility of this technique in routine practice. A minor limitation is that the main outcome of response was defined as an improvement in NYHA functional class, while a more well-validated index of response would be a $\geq 15\%$ decrease in LV end-systolic volume at follow-up.

What the clinical cardiologist needs is parameters which indicate the mechanical dyssynchrony amenable to resynchronisation therapy, i.e. the contractile reserve which is recruited by CRT. However, what the clinician wants is a single echocardiographic parameter easily obtained with a high reproducibility. If the echocardiographic examination moves towards this more reliable assessment of dyssynchrony it also moves away from the simple single binary echocardiographic parameter due to the increased post-processing time and the required expertise.⁸ Techniques such as TDI deformation imaging require training and expertise and have several relevant limitations,⁹ especially in patients with heart failure in whom the dilated ventricle precludes optimal alignment.¹⁰ Perhaps speckle tracking would prove to be the preferred technique since it is angle independent, has a high feasibility, and is more user friendly than TDI. A final consideration in this respect is that the evaluation of only the difference of peak longitudinal deformation might be an oversimplification of a complex pathophysiological process. Is the time difference to peak longitudinal deformation a reflection of the uncoordinated contraction of different LV segments? Recent experimental studies have shown us that discoordination within the LV, rather than dyssynchrony, predicts reverse remodelling after CRT.¹⁰ Whether this evaluation can be implemented in the average CRT population remains to be investigated.

Will deformation imaging, which is even more user dependent than tissue velocity, hold up its promise? The findings by Scheffer et al. suggest it will and are in line with other small studies, indicating a potential role for deformation imaging in this setting.^{5,7} Nevertheless, single-centre studies with very promising findings should always be interpreted with great caution, even more so those with a retrospective study design providing findings in patients with optimal acoustic windows. High expectations could lead to great disappointment when the limitations are not highlighted.³ Despite the limitations the findings presented will ultimately guide the way to a more reliable param-

eter, or, more likely, an algorithm which will guide clinicians to distinguish potential responders from nonresponders. Indeed, several recent studies have suggested that a multiparametric echocardiographic strategy is needed to guide clinical decision-making in heart failure patients for CRT.^{12,13} ■

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