Cardiac resynchronisation therapy and the role of optimal device utilisation

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Despite established selection criteria, 30 to 40% of patients do not respond to cardiac resynchronisation therapy. By optimising programming of the device response to cardiac resynchronisation, therapy can be improved. (*Neth Heart J* 2009;17:354-7.)

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Heat failure is the fastest growing cardiovascular diagnosis; the lifetime risk is estimated at nearly 20%. According to epidemiological studies, an estimated 22.5 million people suffer from heart failure worldwide.¹ Cardiac resynchronisation therapy (CRT) has been developed as a pacemaker technology that aims at resynchronising the cardiac contraction in order to improve cardiac pumping efficiency. Large CRT trials have shown substantial improvements in patient morbidity and mortality and CRT is therefore considered a major revolution

in the treatment of patients with drug refractory heart failure.^{2,3} Despite impressive results, a large proportion of patients do not respond to CRT (30-40%). Optimal pharmacological treatment and optimal programming of the device are essential to improve further response to CRT. The present review discusses possibilities to improve response to CRT.

Optimal left ventricular lead positioning.

Selection criteria for cardiac resynchronisation therapy are currently New York Heart Association (NYHA) class III-IV for heart failure despite optimal pharmacological therapy, left ventricular ejection fraction (LVEF) $\leq 35\%$, left ventricular end-diastolic diameter (LVEDD) ≥ 55 mm and a QRS > 120 ms.⁴ Placement of the LV lead at the point of maximal dyssynchrony improves the response percentage (figure 1).^{5,6}

However, left ventricular lead positioning at the point of maximal dyssynchrony can be difficult to achieve due to the fixed anatomy of the coronary sinus and its branches.⁶ If a patient is a non-responder, defined as a decrease in left ventricular end-systolic volume (LVESV) $< 10\%$ after six months of follow-up, repositioning may be an option, if the patient otherwise seems a good candidate for CRT. Ultimately, a guided epicardial lead positioning may be an option.⁷

Optimalisation of device programming

After implantation of the device, programming of the device is of pivotal importance and should be optimised for the individual patient. Initially, an AV optimisation is needed to ensure an optimal diastolic filling time and to abolish presystolic mitral valve regurgitation, frequently seen in chronic heart failure patients due to ventricular dilation or papillary muscle dyssynchrony.⁸ Furthermore, the heart rate response needs to be evaluated. Heart rates exceeding the

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Figure 1. Measurement of the septal to lateral delay, a dyssynchrony measurement to determine intra-ventricular dyssynchrony. Time difference between the maximal myocardial velocity septal (yellow curve) and lateral wall (blue curve) represents the septal to lateral delay.

upper rate of the device during moderate exercise compromise effective biventricular pacing (figures 2A and B). Ideally, each patient should undergo an exercise test after one to two months to assess heart rate response.⁹ A too high heart rate response during exercise can often be prevented by increasing the β -blockade dosage. Sometimes, predominantly in patients with atrial fibrillation, atrioventricular junction ablation is performed.¹⁰ Besides too high heart rate responses during exercise test, chronotropic incompetence may occur, e.g. due to high dosages of β -blockers and/or amiodarone, or sinus node remodelling due to the underlying disease.⁹ This can easily be overcome by starting rate adaptive pacing. It should be noted in this respect that estimates of percentage pacing delivered by the device can easily overestimate the percentage of biventricular pacing since fusion pacing or ineffective pacing due to an earlier own ventricular activation cannot be distinguished from effective pacing.⁹

Atrial fibrillation and response to CRT

Atrial fibrillation is the most common arrhythmia in chronic heart failure patients. Most studies evaluating the effect of CRT are performed in highly selected groups, i.e. patients in sinus rhythm.^{2,3} Currently, there is more evidence that AF patients also benefit from cardiac resynchronisation therapy. The need for an atrioventricular junction ablation, as mentioned above, is still a point of debate. If heart response assessment shows effective biventricular pacing, also during exercise, there does not seem to be a need for atrioventricular junction ablation.¹¹ Clearly, assessment of the percentage of biventricular pacing should not be evaluated by interrogation of the device.⁹

Approximately 15 to 25% of the patients treated with CRT develop new onset AF during follow-up.^{12,13} AF during follow-up may reduce the effectiveness of cardiac resynchronisation therapy due to high ventricular heart rates, especially during

Figure 2. A: Biventricular pacing during a heart rate of 120 beats/min. B: Recurrence of left bundle branch block conduction during exercise at the moment the heart rate exceeds the upper rate (here a heart rate of 145 beats/min is present, while the upper rate was set at 130 beats/min). Pacing spikes are no longer present.

Figure 3. Flow chart showing how to treat and optimise the CRT recipient.

(moderate) exercise. Consequently, the development of new-onset AF should be closely monitored. New device tools, such as home monitoring, may improve early detection of AF and accordingly improve outcome of CRT.^{14,15}

The flow chart suggests follow-up and routine investigations in patients treated with CRT (figure 3). ■

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