

# Cardiac Resynchronization Therapy for Heart Failure



Amole Ojo, MD, Sohaib Tariq, MD, Prakash Harikrishnan, MD,  
Sei Iwai, MD, FHRS, Jason T. Jacobson, MD, FHRS\*

## KEYWORDS

- Cardiac resynchronization therapy • Heart failure with reduced ejection fraction • Dyssynchrony
- Biventricular pacing

## KEY POINTS

- Cardiac resynchronization therapy (CRT) is indicated (Class I) for patients with ejection fraction no more than 35%, left bundle branch block (LBBB) with QRS duration  $\geq 150$  milliseconds and at least Class II New York Heart Association class symptoms despite optimal medical therapy.
- CRT can improve hemodynamic status, left ventricular structure and function, mitral regurgitation, and functional status.
- The benefit of CRT is less clear in patients with QRS duration of 120 to 150 milliseconds.
- There is no clear evidence that patients with non-LBBB conduction delay benefit from CRT.

## INTRODUCTION

Guideline-directed medical therapy, such as angiotensin-converting enzyme inhibitors, beta blockers, and spironolactone have improved symptoms and survival in patients with heart failure with reduced ejection fraction (HFrEF). Reduction in left ventricular ejection fraction (LVEF) is seen commonly in an aging population, and hospital admissions with heart failure (HF) contribute significantly to the economic burden in this population. Implanted devices, such as implantable cardioverter–defibrillators (ICDs) and pacemakers are also beneficial in such patients, especially the recommended use of ICDs for the primary prevention of sudden arrhythmic death in ischemic and nonischemic cardiomyopathy patients. In patients with HF and bundle branch block, cardiac resynchronization therapy (CRT), which involves simultaneous pacing of both right and left ventricles (biventricular pacing), is beneficial. Prognosis in HF patients is poor, but with wide use of these therapies in the last 2 decades, median life expectancy has improved. Worse prognosis is also seen

in patients with ventricular conduction delay. In a retrospective study of 241 HF patients by Shamim and colleagues,<sup>1</sup> after 36 months of follow-up, the mortality rate was 20% in the group with QRS less than 120 milliseconds, 36% in the group with QRS of 120 to 160 milliseconds, and 58.3% in the group with QRS greater than 160 milliseconds.

## SEQUELAE OF CONDUCTION ABNORMALITIES AND DYSSYNCHRONY IN HEART FAILURE

In patients with HF, assessment of conduction abnormalities via 12-lead electrocardiogram (ECG) is essential to determine eligibility for CRT. Interatrial conduction delay, prolonged PR interval, QRS duration greater than 120 milliseconds, right bundle branch block (RBBB), left bundle branch block (LBBB), and non-specific intraventricular conduction disturbances (IVCD) are commonly seen in HF patients.

Worsening HF symptoms and poor outcomes are associated with LBBB.<sup>2</sup> Inter- and intraventricular dyssynchrony is commonly seen in

Disclosure Statement: J.T. Jacobson – St. Jude Medical, consultant. S. Iwai – Biotronik, speaker. Division of Cardiology, Westchester Medical Center, New York Medical College, 100 Woods Road, Valhalla, NY 10595, USA

\* Corresponding author.

E-mail address: Jason.Jacobson@wmchealth.org

Intervent Cardiol Clin 6 (2017) 417–426  
<http://dx.doi.org/10.1016/j.iccl.2017.03.010>  
2211-7458/17/© 2017 Elsevier Inc. All rights reserved.

patients with HF and LBBB, regardless of the QRS duration. In intraventricular dyssynchrony, late activation of the lateral wall of the left ventricle (LV) occurs in comparison to the inter-ventricular septum. Ventricular dyssynchrony can worsen HF by reducing the efficiency of contraction and causing ventricular remodeling leading to pump failure. Its impact is significant in patients with underlying LV dysfunction.

### FAVORABLE EFFECTS OF RESYNCHRONIZATION

Cardiac resynchronization therapy helps improve atrioventricular (AV) delay and corrects ventricular dyssynchrony, through which an improvement is seen in both left ventricular (LV) performance and mitral regurgitation. Due to coordinated contraction, a rise in systolic pressure and decrease in intracardiac filling pressures are seen. In the Cardiac Resynchronization—Heart Failure (CARE-HF) trial, LVEF increased by an absolute 3.7% at 3 months and 6.9% at 18 months from a baseline of 25% in the CRT group when compared with medical therapy.<sup>3</sup> Reduction in IVCD, mitral regurgitation, and end-systolic volume index was also seen.<sup>3</sup> In the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) trial, significant improvement in LVEF (absolute 3.6% vs 0.4%) and reduction in mitral regurgitation was seen in patients with HFrEF treated with CRT compared with medical therapy.<sup>4</sup> Importantly, the improvement in ventricular contractility due to CRT does not appear to cause an increase in myocardial oxygen demand.<sup>5</sup> Improved contractility is seen at higher heart rates in patients with CRT compared with LV-only pacing, further enhancing exercise capacity.<sup>6</sup>

Biventricular (BiV) pacing reverses the harmful effects of LV remodeling. In the MIRACLE trial a reduction in LV mass was seen. CRT helps with reduction in intracardiac filling pressures, improvement in cardiac index, and toleration to aggressive up titration of medical therapy including beta blockers.<sup>7,8</sup> Improved diastolic function is also observed in patients treated with CRT, a result of the beneficial remodeling.<sup>9</sup> However, not every patient treated with CRT will respond in this way. The rate of nonresponse to CRT has been estimated to be around 20% to 30%.<sup>10</sup> Factors that predict response will be discussed later in this article. It is also of note that the placebo effect in the control group in some of the CRT studies is not insignificant. In the MIRACLE trial, for example, the clinical composite HF score of 39% of patients in the control group also improved.<sup>11</sup>

### PACING IN HEART FAILURE

Right ventricular (RV) pacing is a cause of ventricular dyssynchrony and is not recommended in patients with HFrEF, as it reduces the efficiency of cardiac pump function and exacerbates heart failure symptoms. The right ventricle contracts before the left ventricle, which leads to interventricular dyssynchrony. This results in an iatrogenic LBBB, with late activation of the lateral wall compared with septum, hence causing intraventricular dyssynchrony.

In the Dual Chamber and VVI Implantable Defibrillator (DAVID) Trial, the effect of dual-chamber (right atrial [RA] and RV) pacing in HFrEF patients (mean LVEF 27%) was associated with worse outcomes (ie, higher mortality and hospitalizations for HF) when compared with VVI pacing with a lower rate limit of 40 beats per minute (VVI-40).<sup>12</sup> RV pacing was significantly higher in dual-chamber pacing group (60%) compared with the VVI-40 group (1%).<sup>12</sup> RV pacing more than 40% of the time greatly increased the risk of poor outcomes.<sup>12</sup> Post-hoc analysis of data from the MMode Selection Trial (MOST) study also showed that ventricular pacing is associated with increased hospitalizations of HF patients even with baseline QRS duration less than 120 milliseconds.<sup>13</sup> The DAVID II trial compared atrial pacing with back-up ventricular pacing (VVI-40), and no difference was seen in event-free survival and quality of life between both groups,<sup>14</sup> adding further evidence for the deleterious effects of RV pacing.

### OPTIMAL HEART FAILURE PATIENT SELECTION FOR RESYNCHRONIZATION

There is strong evidence of beneficial effects of CRT in patients with New York Heart Association (NYHA) Class III HF by improving symptoms, exercise capacity, and LF function. LVEF no more than  $\leq 35\%$  and QRS duration of at least 120 to 150 milliseconds were the inclusion criteria in most of the trials. The CARE-HF and Comparison of Medical Therapy, Pacing and Defibrillation in Heart Failure (COMPANION) trials showed significant reduction in all-cause mortality and hospitalizations for HF.<sup>3,15</sup> In the MIRACLE trial, improvement in NYHA class was seen as early as 1 month.<sup>11</sup> A meta-analysis included 14 randomized controlled trials with 4420 patients. All patients had LV systolic dysfunction (mean LVEF range 21%–30%), prolonged QRS duration (mean range, 155–209 milliseconds), and most had NYHA Class III and IV symptoms despite being on optimal medical therapy.<sup>16</sup> Reduction in hospitalizations by 37% and all-cause mortality

Download English Version:

<https://daneshyari.com/en/article/5605768>

Download Persian Version:

<https://daneshyari.com/article/5605768>

[Daneshyari.com](https://daneshyari.com)