

## Cardiac Resynchronization Therapy 2018: An Echocardiographer's Point of View

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Cardiac resynchronization therapy (CRT) has been one of the greatest achievements in the treatment of heart failure in the past twenty years.

In this period, since the initial publication of Cazeau et al.,<sup>1</sup> in 1994, many studies have proved its efficacy in reducing symptoms and improving morbidity and mortality in this prevalent condition.<sup>2-5</sup>

The evolution of this therapy has been very speedy and, today, most resynchronization pacemakers are implanted intravenously, rather than through the thoracotomy required in the initial studies. Much has been learned mainly about the population of patients who are likely to benefit from this therapy, – an expensive invasive therapy that has established, or has made popular, a new category of efficacy – the responder group and the non-responder group.<sup>6</sup>

Major studies conducted in this period have established that about 30% (20 to 40%) of patients treated with CRT do not show any improvement or eventually get worse and are considered non-responders.

The guidelines of the American and European cardiology societies about the degree of recommendation of this therapy have undergone minor modifications in this period and it is now established that this is a therapy with proven benefits for patients without coronary artery disease with left ventricular failure with left bundle branch block, in sinus rhythm and in non-terminal stage of the disease.<sup>7</sup> For patients with atrial fibrillation and other etiologies of cardiomyopathies, CRT may be beneficial, depending on several other factors and clinical judgment.

In these guidelines, echocardiography has a secondary role in determining whether the ejection fraction is reduced ( $\leq 35\%$ ) and whether the left ventricle (LV) is dilated (a condition that is no longer necessary in the most recent update of the guidelines).

Several studies performed in centers with a focus on CRT suggested that echocardiography would be able to identify mechanical dyssynchrony, in addition to electrical dyssynchrony on electrocardiography, and thus improve the selection of patients referred to this therapy, which so far has been associated with a failure rate of around 30%

(non-responders). The recommendation of resynchronization pacemakers in patients with narrow QRS and mechanical dyssynchrony has been ruled out by several studies and is currently reserved for very specific situations.<sup>8</sup>

In this scenario, a prospective non-randomized multicenter study was performed to determine if any of the twelve echocardiographic parameters proposed in smaller studies would be useful in this selection. The PROSPECT (Predictors of Response to CRT) study used 3 Core Labs to evaluate and measure these parameters and concluded that none of them would be useful in this selection and that the QRS complex duration on ECG was still the main criterion.<sup>9</sup> The problems related to this study were addressed by the author from this point of view back in 2010.<sup>10</sup> Despite all the methodological failures, the PROSPECT study was useful in showing some points:

- There is no single echocardiographic criterion that is capable of making this selection;<sup>11</sup>
- The time to peak criterion by tissue Doppler, hitherto the most used one, has a number of limitations;<sup>12-14</sup>
- Whatever the criterion applied, it must have reproducibility in other laboratories; the PROSPECT study showed varying measures among the 3 Core Labs that reached 70%.

Running a CRT is complex and accurate patient selection is only one of the items required for a successful implementation:<sup>15</sup> it depends on the coronary venous anatomy, on placing the third electrode near the area with the greatest delay of left ventricular activation, absence of fibrosis in this area, stimulation by the resynchronization pacemaker near 100% of the beats and by a factor in which the echocardiography can help a lot – optimization of resynchronization pacemaker.<sup>16</sup> Over all these years when I have been frequently and directly involved in this theme, I participated in a few evaluations of non-responder patients who, mainly after adjusting the AV delay interval, became responders. Another possible adjustment, the interventricular interval adjustment, has been used less frequently and with a value not yet defined – LV and RV are normally activated simultaneously, but the resynchronization pacemakers currently allow a ventricle to be stimulated a few milliseconds before the other.

What would be the current position of echocardiography about the CRT?

I would divide the use of echocardiography in CRT into 3 items:

1. Selection of patients;
2. Evaluation of the CRT results;
3. Resynchronization pacemaker optimization.

### Keywords

Atrial Fibrillation; Heart Failure; Stroke Volume; Ventricular Dysfunction, Left; Echocardiography.

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## Selection of patients

The subdivision into 3 levels of dyssynchrony is useful and helps to create an evaluation routine. These levels are: atrioventricular dyssynchrony (AV, measured by diastole duration), interventricular dyssynchrony (VV, measured by the time interval between aortic and pulmonary flow) and intraventricular dyssynchrony (measured by the activation time interval between the LV walls).

The first two types of dyssynchrony, AV and VV, are relatively simple to measure using conventional pulsed Doppler (PW), as found in any equipment and is reproducible with minimal differences between operators and laboratories.

Intraventricular dyssynchrony is more complex and can be evaluated by varied techniques<sup>17-22</sup> from M-Mode to 2D strain and 3D echo through the most popular form, the time-to-peak measurement given by the time between electrical activation of the segment analyzed to peak velocity evaluated by tissue Doppler (except for 3D echo, I have used all the methods available in the device that I am using to run the test) – yes, in

real world we do not always have the ideal equipment for that type of test, but I do not think this is an impediment to a useful evaluation by echocardiography in the selection of patients for CRT. In my opinion, we should use a few different criteria to say that a patient needs a resynchronizer and these criteria should be simple and easy to assess. The literature corroborates this view with proposals that vary with the association of two or more criteria.<sup>23</sup>

Finally, the criteria applied to the selection of patients for CRT should be validated in different populations, respecting the limitations and availability of devices, training levels of echocardiographers and clinical characteristics of each population evaluated. The Department of Cardiovascular Imaging (DIC) of the Brazilian Society of Cardiology (SBC) intends to carry out a study to show the use of echocardiography in the selection of patients for CRT in the Brazilian population. This study will definitely contribute significantly to the better understanding and refinement of patient selection for CRT.

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