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The Significance of Left Axis Deviation in Response to CRT

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Cardiac Resynchronization Therapy (CRT) has emerged as the mainstay electrical pacing modality to improve left ventricular mechanical function by changing the sequence of electrical activation, leading to a significant reduction in mortality rate and hospitalization due to Heart Failure (HF). Despite these significant benefits, many patients receiving CRT are subjected to device complications and costs. Therefore, increasing attention to determine the variables associated with improved "response" to CRT is merited.

A significant degree of dyssynchrony is required for benefitting from CRT. CRT benefits have been established in patients with HF and Left Bundle Branch Block (LBBB). However, several studies have shown that patients without significant Left Ventricular (LV) conduction delay, particularly those with Right Bundle Branch Block (RBBB) or non-specific Intraventricular Conduction Delay (IVCD), were not likely to benefit from biventricular pacing (1, 2).

The physiology of conduction system disease is highly distinctive and, consequently, needs to be tailored to the patient's underlying pathophysiology; LV lead placement into an accessible tributary of the coronary sinus might not address the needs of an individual patient. A more profound mechanistic understanding of the benefits of CRT and precise diagnosis of the level and extent of conduction system pathology could improve the outcomes. Some studies have suggested that one-third of patients meeting the criteria for LBBB might not have true complete LBBB, but might have a combination of LV hypertrophy and left anterior fascicular block. Thus, further studies are needed to reinvestigate the conventional electrocardiographic criteria for complete LBBB and its influences on response to CRT (3).

Multiple previous studies revealed that patients with Left Axis Deviation (LAD) and LBBB benefitted less from CRT compared to other LBBB patients. LBBB and LAD patients show a specific pattern of ventricular asynchrony with the latest activation at the anterior wall, which is a reflection of poor electromechanical substrate. The presence of this pattern could affect target vessel selection during CRT procedures in these patients, making them less likely to have electromechanical resynchronization. Suboptimal CRT-response might be explained by structural myocardial changes associated with LAD (4, 5). LBBB and LAD have been reported to be associated with more scar tissues, hypertrophy, and less activation delay.

In a retrospective analysis of the MIRACLE and MIRACLE ICD data, there was no significant difference between the study groups regarding the response measures. Nonetheless, both Minnesota Living with Heart Failure (MLHF) and 6-Minute Walk Test (6MWT) trended towards a better response in patients without LAD ($P = 0.19$ and $P = 0.14$, respectively) (6). Nikoo et al. (7)s reported that the response to resynchronization therapy was significantly lower in patients with LBBB and LAD compared to those with a normal axis. The benefit was assessed via combined simple echocardiographic and clinical variables. Nonetheless, these findings were derived from a single population study and should be considered descriptive rather than predictive. Furthermore, some studies have shown that additional clinical parameters, including scar burden and areas of delayed activation, affected the response to CRT.

Nevertheless, the relation between LV lead position and scar burden and location may be associated with response to CRT. These unmeasured parameters that might affect the CRT response beyond Electrocardiogram (ECG) parameters were not available in their study. The assessment of electromechanical delay using echocardiography might be beneficial, as well. The integration of imaging modalities with ECG measures in future studies is of ongoing interest.

Prognostic assessment in HF patients is complex due to different patterns of disease progression. Accurate prognostic information is fundamental to optimal clinical care.

The ECG has still an important place in developing criteria for selecting patients for CRT. Hence, further studies are required to better delineate the electrocardiographic criteria for complete LBBB in order to find the patients who might benefit most.

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