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A Review of Cardiac Resynchronization Therapy: Present and Future

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Abstract

Cardiac resynchronization therapy (CRT) has been established as a standard treatment for heart failure. The effectiveness of CRT has been shown in many clinical trials and realized in actual clinical practice. Nevertheless, underutilization of CRT is a major problem in the treatment of heart failure. One factor leading to underutilization is the existence of CRT non-responders. CRT non-response has been discussed for approximately 20 years, since CRT was introduced. Since the beginning, the CRT non-response rate has been reported to be 30%. However, we are now undergoing a major transformation in the thinking about CRT response. First, heart failure is a progressive disease.

Keywords: Dyssynchrony; biventricular pacing; cardiac resynchronization therapy; cardiomyopathy

Introduction

According to the most recent guidelines, cardiac resynchronization therapy (CRT) is recommended for symptomatic heart failure patients in sinus rhythm with a QRS duration ≥150 ms and left bundle branch block (LBBB) QRS morphology and with left ventricular ejection fraction (LVEF) ≤35% despite optimal medical therapy to improve symptoms and reduce morbidity and mortality. Consequently, there is a great need for tools that might help in optimal patient selection and provide prognostic information for the patients and their families. Ever since the first implementation of CRT, several clinical factors and biomarkers have been tested in prediction models to identify those patients who might benefit the most from the therapy.

Placement of the left ventricular lead is commonly performed by using a transvenous approach via the subclavian vein and superior vena cava, which allows cannulation of the coronary sinus with specially designed sheaths. After cannulation of the coronary sinus, retrograde venography is performed to identify coronary sinus anatomy. The pacing lead is then advanced into the target vein, ideally in the area of the left ventricle with the greatest delay in contraction. This additional lead is placed via the right atrium and coronary sinus into the lateral, posterolateral, or anterolateral branches of the coronary venous system. Optimal lead placement is dependent on the presence of an acceptable target vein, adequate pacing capture threshold, lack of stimulation of the phrenic nerve and/or diaphragm, and lead stability.

Factors associated with CRT underutilization

First, the existence of CRT non-responders seems to be a major factor in the hesitation to introduce CRT. It has been reported that 30% of patients are non-responders. This percentage is large enough to discourage CRT implantation among many physicians. Since CRT is an invasive treatment that requires hospitalization, the idea that patients only be burdened if it does not work is undeniable.

Left ventricular septal pacing

Left ventricular septal pacing (LVSP) is another promising alternative to achieve a more direct LV electrical activation, by pacing the LV endocardial side of the interventricular septum (IVS). During sinus rhythm with a normal interventricular conduction through the His–Purkinje system, the activation of the LV starts in the LBB.

His-bundle pacing

The HBP stimulates the His–Purkinje system and restores the physiological activation of both ventricles. Described for the first time in 1970s, this technique has demonstrated to be feasible and safe in different settings, improving functional NYHA class, reversing cardiac remodelling and increasing ejection fraction.

Left bundle branch area pacing

Considering HBP limitations, pacing the conduction system distal to His bundle has been proposed to bypass the potential block region and achieve a more distal and profound cardiac resynchronization.

Conclusion

CRT is an effective treatment for selected patients with chronic HF and a prolonged QRS interval. It is one of the most powerful recent advances for reducing morbidity and mortality in the challenging HF population. Ongoing and future trials will continue to investigate ways to improve the nonresponse rate of approximately 30% through improved patient selection. Unsettled issues lie mostly for patients in atrial fibrillation, narrow QRSd (<120 ms), mildly symptomatic heart failure, and right bundle branch block.

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