Invited Editorial:

Optimizing Resynchronization Pacing in the Failing Systemic Right Ventricle

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Abstract:

Cardiac resynchronization pacing therapy (CRT) can be a potentially effective modality to delay the need for heart transplantation and improve the clinical status among patients with heart failure. Unfortunately, published guidelines and studies with an over-reliance on ejection fraction (EF) and QRS duration as markers for efficacy are frequently not applicable to the ever-growing number of adults with repaired congenital heart defects (CHD), some with systemic anatomical right ventricles as well as pre-existing pacemakers. In this issue of *Pacing and Clinical Electrophysiology*, Moore et al introduce a novel pre-selection screening process to optimize paced contractility among patients with repaired CHD and systemic right ventricles. In this study, six patients, with a failing right ventricle, underwent a hybrid cardiac catheterization technique to optimize epicardial ventricular lead placement utilizing 3-dimensional ventricular epi-endocardial electro-anatomical mapping to identify the area of late activation. Once identified, the epicardial lead was placed and joined with the transvenous lead placed in the venous left ventricle. Confirmation of efficacy was determined by both QRS duration as well as echo-derived fractional area of change combined with improvement in NYHA classification. At a median follow-up of 11 months, 5 patients showed significant improvements in measured variables while 1 patient demonstrated some clinical improvement which delayed transplant for a year. Although there have been several publications of CRT pacing among patients with repaired CHD, results have been variable, primarily due to selection criteria. This current study introduces an innovative approach to epicardial lead placement to optimize contractility.

Biventricular or cardiac resynchronization pacing therapy (CRT) is a now established modality to potentially improve clinical outcomes as well as delay the need for cardiac transplant among patients with systemic ventricular failure. However, published Guidelines for patient selection do not include the surgical interventions and anatomical variations, including a systemic right ventricle (RV), seen in the ever-growing number of adult patents with repaired congenital heart defects (CHD), including those with repaired transposition of the great arteries (TGA). In addition, Guidelines do not address the issue of pre-existing pacemakers which are commonly found among these patients. Since these young adults can be expected to develop early ventricular dysfunction and clinical heart failure, based simply on cardiac anatomy, and regardless of any coronary issues, it is imperative to explore therapeutic modalities that address the unique clinical challenges found in this patient population. Although CRT has been applied to CHD patients using current recommendations for patient selection, efficacy and clinical improvement rates have been variable. The over-reliance on QRS morphology as well as ventricular ejection fraction (EF) as primary markers of CRT efficacy, commonly reported among many publications, including Guidelines, has recently come under scrutiny and questioned in an era of improved diagnostic imaging to detect changes in ventricular contractility (1-3).

In this issue of *Pacing and Clinical Electrophysiology,* Moore et al (4) present a novel approach to determine the best epicardial lead implant site among 6 patients with TGA and previously implanted transvenous cardiac rhythm devices, utilizing current mapping techniques found in most cardiac electrophysiology laboratories. Electro-anatomical mapping (EAM) provides 3-dimensional intracardiac electrical activation sequences in relation to anatomy in a cardiac chamber of interest. Typically applied during arrhythmia mapping, EAM decreases the need for fluoroscopy as well as to provide more precise substrate location, necessary for accurate ablation. The hybrid catheterization laboratory technique employed in this study entails a minimally invasive surgical approach to right ventricular epicardial lead implant based on the findings of mapped late activation (7). Once the epicardial lead was implanted, the lead was advanced to join with the established transvenous lead in the venous left ventricle to finalize the CRT pacing system. On a follow-up interval from 5 -13 months, clinical improvement, based on QRS duration as well as echo-derived fractional area of change (FAC) and NYHA clinical classification occurred in all patients with 5 patients being removed from transplant consideration and 1 receiving a transplant a year later.

Evaluation of systemic RV function poses a unique challenge to clinicians. The anatomical shape as well as difficulties to achieve optimal visualization during cardiac ultrasound studies often negates EF as an effective measurement of contractility. In this study, FAC was used, which in addition to other non-invasive techniques, such as strain, dP/dt and tissue-Doppler, can be more effective markers of contractility (8). Additionally, the authors astutely report that the activation sequences are patient variable. This important observation confirms previous reports that there is no "one best" implant site to optimize paced contractility (8). In this regard, the simple practice of merely implanting two ventricular leads, without knowledge of which locations ensure optimal response is an outdated and ineffective approach to pacing lead implant.

In the current era of technological advances, newer methods to more effectively measure myocardial contractility need to be explored. This is especially true considering morbidities associated with CRT implant. Moore et al, introduce an effective combination of EAM with precise epicardial lead implant to optimize paced contractility in a difficult clinical situation of patients with systemic right ventricles and early heart failure.

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