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LETTER TO THE EDITOR

Left bundle branch area pacing: A new era of cardiac resynchronization therapy?

Carlo Alberto Caruzzo, Elia Rigamonti, Francesca Romana Scopigni

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Abstract

The recent systematic review and meta-analysis provided a comprehensive focus on the current state of cardiac resynchronization therapy (CRT). The authors determined the feasibility of physiological left bundle branch area pacing (LBBAP) in patients indicated for CRT through a careful analysis of trials. They found that LBBAP was associated with significant reductions in QRS duration, New York Heart Association functional class, B-type natriuretic peptide levels, and pacing thresholds as well as improvements in echocardiographic parameters compared to biventricular pacing.

Key Words: Left bundle branch pacing; Biventricular pacing; QRS duration; Left ventricular ejection fraction; Heart failure

Core Tip: In heart failure, conduction defects, such as left bundle branch block, are common and result in regionally delayed electrical activation. Traditional pacing modalities, such as biventricular pacing, are non-physiological and directly stimulate the common myocardium, which may limit the clinical response. Left bundle branch area pacing bypasses the pathological region of the cardiac conduction system and leads to near-physiological or true conduction system pacing for patients needing ventricular pacing for bradycardia or heart failure. There is increasing interest in physiological pacing techniques that can directly activate the specialized conduction system.

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TO THE EDITOR

Current state and challenges of cardiac resynchronization therapy

Cardiac resynchronization therapy (CRT) with biventricular pacing (BiVP) is an established therapy for patients with left ventricular ejection fraction ≤ 35%, heart failure symptoms, and left bundle branch block with a QRS duration ≥ 150 ms or expected frequent ventricular pacing of > 20%-40%[1-4]. Over the last 25 years several randomized controlled trials have shown that CRT with BiVP reduces heart failure hospitalization (HFH) and all-cause mortality[4-7].

Left bundle branch area pacing (LBBAP) is a newer procedure for CRT that has shown promising results. A retrospective study demonstrated a statistically significant reduction in the composite outcome of death and hospitalization in patients receiving LBBAP[8]. Moreover, stimulation of the left bundle branch is a more physiological approach. It leads to a significant reduction in QRS duration[8], resulting in improved echocardiographic parameters such as ejection fraction and left ventricular end-systolic volume. This in turn translates to clinical improvements such as New York Heart Association (NYHA) functional class and quality of life[9].

LBBAP is the most recent technique established for conduction system pacing. It overcame several limitations of its predecessor, His-bundle pacing (HBP). The stimulation of the left bundle branch often shows lower thresholds, resulting in longer battery life compared to HBP[10]. Despite the initial success of the first conduction system pacing through HBP, widespread use of CRT was hindered by issues such as lead instability, dislodgements, a steep learning curve, and rapid battery depletion.

The aim of this editorial was to expound on the recent meta-analysis regarding LBBAP by Yasmin *et al*[11] in the *World Journal of Cardiology*. LBBAP is a safe and effective means for achieving physiological conduction system pacing. It involves the placement of the pacing lead tip into the left side of the interventricular septum, 15-20 mm beyond the tricuspid annulus on fluoroscopic imaging[12]. Appropriate lead placement is confirmed through various criteria, including left ventricle activation time < 80 ms and V6-V1 interpeak interval > 44 ms[13]. Left ventricle activation time is illustrated in Figure 1.

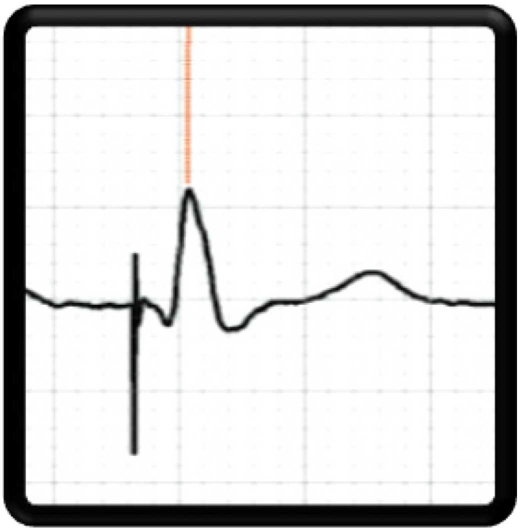

Figure 1 Left ventricle activation time is the time from the pacing artifact to the peak R wave in V6. The difference between V6 and V1 R-wave peak times is the interpeak interval. It helps clinicians distinguish between selective and non-selective left bundle branch area pacing and septal pacing. The larger the interval, the less selective the catheter will be with respect to the conduction system.

The current literature suggests that conduction system pacing is a valid alternative in terms of safety[14]. LBBAP results in a lower risk of all-cause mortality or HFH compared to BiVP and left ventricular septal pacing (LVSP), while LVSP and BiVP have a similar risk. LVSP had a higher risk of all-cause mortality compared to both LBBAP and BiVP. The echocardiographic response and super response were highest for patients treated with LBBP[15].

Choosing the ideal site for CRT is often difficult using conduction system pacing, especially in patients without left bundle branch block due to the risk of conduction block progression distal to the pacing site. Therefore, HBP and epicardial left ventricular (LV) pacing or LBBAP and epicardial LV pacing may be better options to optimize results in patients without left bundle branch block[16].

KEY ASPECTS OF LBBAP

Yasmin *et al*[11] reported in the meta-analysis that the baseline characteristics of the population were well-balanced according to sex (49.7% female). Subzposh *et al*[17] reported that females are better responders to resynchronization therapy. The meta-analysis included 389 patients with heart failure and left bundle branch block from six studies. Only one of the studies was randomized, and the median follow-up was 9 months. QRS duration was the primary outcome and was significantly reduced by LBBAP. This result is fundamentally important in corroborating the effectiveness of direct stimulation of the conduction system.

The propagation speed through the myocardium is 0.15-1.00 m/s, which is 25% of the physiological speed of the conduction pathways of the heart (3.00-4.00 m/s)[18], highlighting the inherent superiority of physiological pacing through the native conduction system. QRS duration reduction leads to reverse remodeling and avoids interventricular mechanical delay. Patients with greater QRS shortening (> 14 ms) after CRT have lower mortality and hospitalizations compared to those with smaller QRS reductions[19]. Implementing a general strategy of CRT device optimization for shorter QRS duration should lead to better clinical outcomes.

Secondary outcomes included pacing threshold, NYHA functional class, B-type natriuretic peptide level, and echocardiographic parameters such as left ventricular ejection fraction, left ventricular end-diastolic diameter, and left ventricular end-systolic diameter. Five of the included studies reported a significantly reduced pacing threshold in LBBAP compared to BiVP, which also remained considerably lower at the 6-month and 12-month follow-up.

CONCLUSION

We are in full support of the conclusions of Yasmin *et al*[11] about LBBAP as a promising modality, and we await with fervid anticipation the results of ongoing randomized controlled trials. The advantages of LBBAP over BiVP have emerged in recent years and include better ventricular electrical and mechanical resynchronization and improvements in cardiac function, NYHA function class, and clinical outcomes.

Despite these encouraging results, widespread adoption of LBBAP depends on the improvement of tools and further validation of its efficacy in large randomized clinical trials. Furthermore, randomized clinical trials with long-term follow-up are necessary to confirm the clinical benefits of conduction system pacing CRT compared with BiVP in CRT candidates. One of the biggest challenges will be to demonstrate whether this benefit translates into a sustained reduction in HFH or mortality.

FOOTNOTES

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