

# Left bundle branch area pacing after His bundle pacing for cardiac resynchronization in a patient with dextrocardia



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## Introduction

His bundle pacing (HBP) has emerged as an alternative to cardiac resynchronization (CRT) when conventional biventricular pacing is not possible,<sup>1</sup> mainly in patients with complex heart disease. However, high-output energy is needed to narrow the QRS in some cases, rapidly draining the battery and increasing the frequency of generator replacement. We report the first case of left bundle branch area pacing (LBBAP) for CRT in a patient with dextrocardia, persistent superior vena cava, and severe ventricular dysfunction normalized after HBP.

## Case report

We report the case of a 72-year-old man diagnosed with arterial hypertension, diabetes mellitus, permanent atrial fibrillation, and dextrocardia in the setting of situs ambiguus with polysplenia and persistent superior vena cava. In 2018, a failed attempt at resynchronization by biventricular pacing was followed by HBP for CRT owing to a progressive deterioration of the left ventricular ejection fraction (LVEF) after pacemaker implantation for complete atrioventricular block in 2005. As previously reported in this journal,<sup>2</sup> HBP achieved a narrow QRS in this patient and improved his dyspnea and LVEF (from 30% to 45%), although the pacing threshold was elevated (4.5 V at 1 ms). Two years later, in March 2020, the battery failed early owing to the high programmed output energy (7.5 V at 1 ms). The generator was replaced, and LBBAP was performed because it was considered highly likely to maintain synchronicity with a

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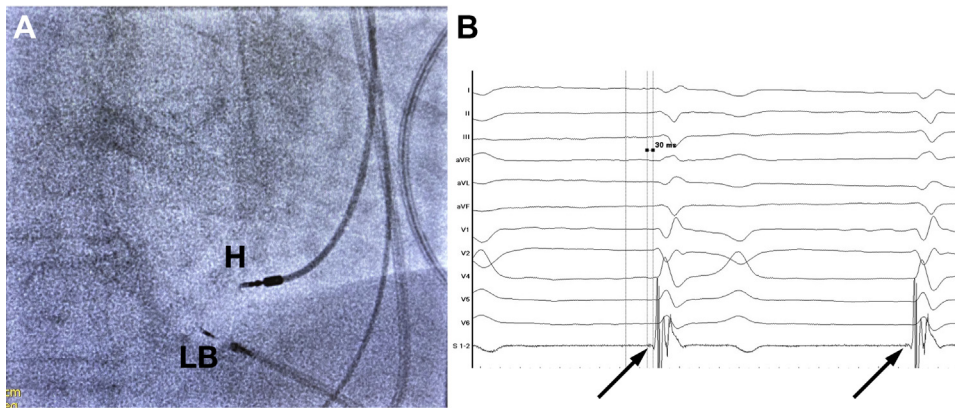
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## KEY TEACHING POINTS

- Physiological pacing is an effective alternative when conventional cardiac resynchronization is not possible. In fact, it obtains narrower stimulated QRS complexes in comparison to the conventional approach while producing similar improvements in ventricular function and functional class.
- Left bundle branch area pacing (LBBAP) achieves physiological ventricular activation via the His-Purkinje system and offers lower pacing thresholds and higher sense R-wave amplitudes in comparison to His bundle pacing.
- The programmed energy output is lower with LBBAP, increasing battery life and reducing the frequency of generator replacement.
- No head-to-head comparative studies have yet been published. Meanwhile, LBBAP should be the approach of choice after the failure of conventional cardiac resynchronization.

low threshold. A lumenless lead (SelectSecure model 3830 69 cm; Medtronic, Minneapolis, MN) was inserted via the left axillary vein through a deflectable sheath (SelectSite C304-L69; Medtronic) connected to a digital recording system (Bard Electrophysiology Lab System, Lowell, MA); the usual fixed-curve sheath (C315HIS; Medtronic) was not used because the curve was in the opposite direction for this patient.

The sheath was advanced 1–2 cm distal to the existing lead in the His bundle in the apical direction (Figure 1A); when paced W morphology was obtained in lead V1, 7–8 rapid clockwise rotations were performed until the notch migrated to the end of the QRS wave and suddenly narrowed. No paced morphology of right bundle block was obtained,



**Figure 1** A: Right anterior oblique fluoroscopy projection. Penetration of lead into the interventricular septum through a deflectable sheath (LB) placed 2–3 cm distal to the old His bundle pacing lead (H). B: Record of left bundle branch potential (arrows). LV interval: 30 ms.

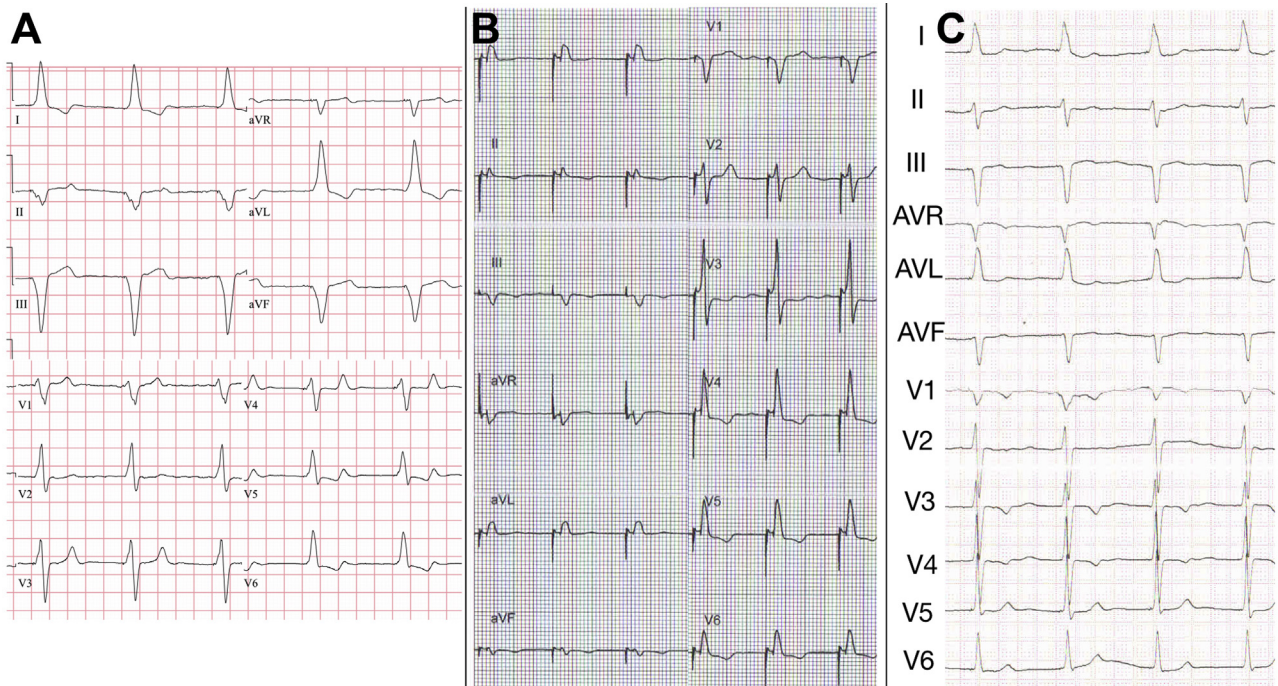
probably owing to intraventricular or left ventricular septal pacing showing paced QRS with terminal notch in V1. The left bundle branch potential was then recorded (Figure 1B). The pacing threshold was 0.5 V at 0.35 ms, and the paced QRS was 124 ms, slightly wider than with HBP (Figure 2). The sheath was removed without complications. The lead was connected to the atrial port of the dual-chamber generator (KORA 250 DR; Sorin Group, Milan, Italy), and the old right ventricle endocardial lead was connected to the backup ventricular port. The lead used for HBP was easily removed with manual traction after unscrewing the helix, with no complication. The fluoroscopy time was 6.7 minutes. We programmed in DDDR mode, ensuring ventricular pacing if there was a loss of LBBAP capture.

One month later, the patient persisted without dyspnea, and the LVEF was maintained at 45%. The threshold was

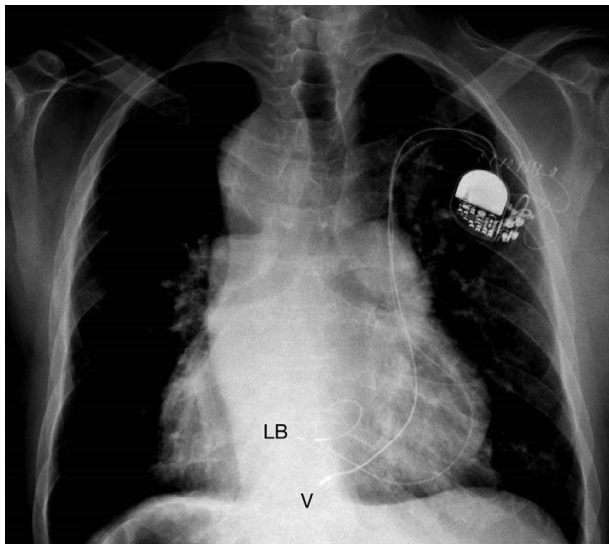
0.5 V at 0.35 ms, the sensed R-wave amplitude was 9.3 mV, and chest radiography revealed well-positioned leads with no complications (Figure 3). The programmed output energy was 2 V at 0.35 ms and the estimated battery life was 12 years.

**Discussion**

Over recent years, various studies have demonstrated the effectiveness of resynchronization with HBP in patients with heart failure, low LVEF, and left bundle branch block.<sup>3</sup> The only randomized trial comparing conventional resynchronization with HBP showed a similar reduction in ventricular volumes and improvements in LVEF and functional class to those obtained with biventricular stimulation, while achieving a higher QRS narrowing rate.<sup>4</sup> These findings support HBP as an alternative option of choice over other



**Figure 2** Panel showing electrocardiogram from the 3 pacing points. A: Pacing from right ventricular endocardium, QRS width of 210 ms. B: His bundle pacing, QRS width of 116 ms. C: Left bundle branch area pacing, QRS width of 124 ms.



**Figure 3** Chest radiography showing right ventricular endocardial (V) and left bundle branch area pacing (LB) leads.

approaches (epicardial, ventricular transeptal) when biventricular pacing is not possible, because it is a less complex procedure and long-term anticoagulation therapy is not needed.

However, the high thresholds required for the correction of a wide QRS produces an early depletion of the battery, increasing the frequency of generator replacement. LBBAP has recently emerged as an approach to physiological pacing,<sup>5</sup> not only for antibradycardia stimulation but also for CRT.<sup>6</sup> Its main advantage over HBP is the low capture threshold. Wu and colleagues<sup>7</sup> compared HBP, LBBAP, and biventricular pacing in 137 candidates for CRT, finding that LBBAP and HBP achieved similar improvement rates in LVEF and functional class (both superior to biventricular pacing) but that LBBAP had a lower threshold (0.49 V vs 1.35 V) and higher R-wave amplitude (11.2 mV vs 3.8 mV). In addition, HBP has been associated with an elevated rate of lead displacement.<sup>8</sup>

Our patient represents a paradigm case of these characteristics. We maintained physiological activation via the His-Purkinje system, obtaining a highly similar paced QRS width (124 ms with LBBAP vs 116 ms with HBP) but a lower threshold for LBBAP (0.5 V/0.35 ms vs 4.5 V/1 ms, respectively), avoiding the need for a more aggressive

approach and increasing the expected battery life. It is also the first reported case of LBBAP in a patient with dextrocardia.

LBBAP did not produce a morphology of right bundle branch block in this patient, which is a criterion of left bundle pacing but not always observed. This phenomenon may be attributable to the simultaneous activation of both branches, the presence of connections between them, or the retrograde activation of the right branch.<sup>9</sup>

Although there have been no head-to-head comparative studies of these physiological pacing techniques, we suggest that LBBAP should be performed when conventional CRT has failed, especially in patients with complex heart disease.

## Conclusions

When CRT is not feasible in patients with complex heart disease, physiological pacing is preferable to epicardial or transventricular approaches. LBBAP has certain advantages over HBP, offering lower thresholds and better sense R-wave amplitudes while achieving similar improvements in functional class, LVEF, and stimulated QRS width.

## References

1. Lustgarten DL, Crespo EM, Arkhipova-Jenkins I, et al. His-bundle pacing versus biventricular pacing in cardiac resynchronization therapy patients: A crossover design comparison. *Heart Rhythm* 2015;12:1548–1557.
2. Molina-Lerma M, Jiménez-Jáimez J, Macías-Ruiz R, Sánchez-Millán P, Tercedor L, Álvarez M. His-bundle pacing in a patient with dextrocardia, severe systolic dysfunction, and complete atrioventricular block. *HeartRhythm Case Rep* 2018;5:148–151.
3. Barba-Pichardo R, Manovel Sánchez A, Fernández-Gómez JM, Moríña-Vázquez P, Venegas-Gamero J, Herrera-Carranza M. Ventricular resynchronization therapy by direct His-bundle pacing using an internal cardioverter defibrillator. *Europace* 2013;15:83–88.
4. Upadhyay GA, Vijayaraman P, Nayak HM, et al. His corrective pacing or biventricular pacing for cardiac resynchronization in heart failure. *J Am Coll Cardiol* 2019;74:157–159.
5. Li Y, Chen K, Dai Y, et al. Left bundle branch pacing for symptomatic bradycardia: Implant success rate, safety, and pacing characteristics. *Heart Rhythm* 2019;16:1758–1765.
6. Zhang W, Huang J, Qi Y, et al. Cardiac resynchronization therapy by left bundle branch area pacing in patients with heart failure and left bundle branch block. *Heart Rhythm* 2018;16:1783–1790.
7. Wu S, Su L, Vijayaraman P, et al. Left bundle branch pacing for cardiac resynchronization therapy: Non-randomized on treatment comparison with His bundle pacing and biventricular pacing. *Can J Cardiol* 2020;S0828-282X(20). 30439-6.
8. Vijayaraman P, Naperkowski A, Subzposh FA, et al. Permanent His-bundle pacing: Long-term lead performance and clinical outcomes. *Heart Rhythm* 2018;15:696–702.
9. Yuqiu L, Keping C, Yan D, et al. Left bundle branch pacing for symptomatic bradycardia: Implant success rate, safety, and pacing characteristics. *Heart Rhythm* 2019;16:1758–1765.