

# Left bundle branch pacing by standard stylet-driven lead: Preliminary experience of two case reports



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## Introduction

Right ventricular (RV) apical pacing has been demonstrated to be potentially harmful, leading to pacing-induced cardiomyopathy in about one-fifth of patients.<sup>1</sup> To avoid pacing-induced cardiomyopathy, physiological pacing has been advocated as a possible solution and His bundle pacing (HBP) has played a prominent role over the last number of years,<sup>2</sup> together with the more recent approach of pacing the left bundle branch (LBB).<sup>3</sup> These 2 modalities of stimulating the heart have merged together in a new definition of His-Purkinje conduction system pacing. Until now, LBB pacing has been performed with only 1 lead with fixed helix (SelectSecure 3830; Medtronic Inc, Minneapolis, MN) supported by the delivery catheter (C315His; Medtronic Inc). A new system designed for directly pacing the His bundle has been recently<sup>4</sup> introduced in a premarket release. We described our preliminary experience of LBB pacing using a standard stylet-driven lead delivered through a specific designed introducer (Biotronik Selectra 3D; Biotronik SE & Co. KG, Berlin, Germany).

## LBB pacing technique

Preparing the system in the surgical table requires to insert the lead in the delivery catheter and then to extend the retractable helix in order for it to be exposed for the subsequent mapping and screwing. After cannulation of the axillary vein, electrophysiological mapping of the Hisian area was performed in unipolar fashion (red alligator clip on the skin and black clip to the tip of the lead) with the pacing lead supported by the delivery catheter (Figure 1) and connected

to both the electrophysiology recording system (Bard LabSystem Pro EP V2.4a; C.R. Bard Inc, Lowell, MA) and the pacing system analyzer (Renamic; Biotronik). The His bundle electrogram was initially recorded for fluoroscopic reference in anteroposterior projection. The whole system, composed of the delivery catheter and the lead inside, was then rotated counterclockwise toward the apex 1–2 cm along the virtual line between the His bundle site and RV apex in right anterior oblique fluoroscopic view. Afterward, in left anterior oblique projection, we confirm the catheter position to be perpendicular to the septum, toward the spinal column as much as possible. While pacing, in left anterior oblique projection, the lead body was manually rotated to engage the previously extended and exposed helix into the septal wall. This maneuver into the septal wall resulted in partial helix retraction, which required further helix-lead screwing from the tip of the lead using normal helix extension. These alternating maneuvers of rotating the body of the lead and the extension of the helix were performed 2–3 times to fully penetrate the ventricular septum under fluoro control. While rotating the lead we focus on paced QRS morphology on electrocardiogram (ECG) and lead impedance changes as described by Chen and colleagues.<sup>5</sup> Lead V<sub>1</sub> moves from a wide “W” shape with a notch at the nadir of the QRS to a right bundle block morphology. In lateral precordial leads V<sub>4</sub>–V<sub>6</sub> the left ventricular (LV) activation time, defined as the stimulus to the peak of the R wave, progressively shortens. Selective LBB pacing was defined as only capturing the LBB without myocardial capture, with ECG pattern depicting the stimulus artefact followed by a small isoelectric line and a typical morphology of right bundle branch block in V<sub>1</sub>. Moreover, a discrete local component separate from the stimulus artifact on the unipolar electrogram (EGM) from the LBB pacing lead is observed. Nonselective LBB pacing is defined as capturing both the LBB and the local myocardium, with ECG pattern characterized by a small pre-excitation following the artefact stimulus; EGM does not record a discrete potential.<sup>6</sup> Sensing and pacing thresholds were recorded in a unipolar and bipolar manner. LBB potentials are recorded when possible to confirm proper position. Before cutting of the sheath, a small amount of contrast

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## KEY TEACHING POINTS

- Left bundle branch (LBB) pacing together with His bundle pacing (HBP) merges in the so-called His-Purkinje conduction system pacing. LBB pacing seems to have better electrical parameters with high ventricular sensing and low threshold.
- All the published experiences of LBB pacing, until now, have been performed with the Medtronic system (Medtronic, Minneapolis, MN), composed of a 3830 4F lead with fixed helix and a fixed-curve sheath (C315 SelectSite). The isodiametric shape between lead body and the helix facilitates ease of screwing into the ventricular septum.
- Our preliminary experience of LBB pacing using a standard stylet-driven lead delivered through a specific designed introducer (Biotronik Selectra 3D, Biotronik SE & Co. KG, Berlin, Germany) opens the possibility of pacing the LBB also with a standard stylet-driven lead with a retractable helix coupled with the Selectra 3D introducer.

dye (5 mL) was injected through the delivery catheter to confirm the location of the lead.

## Case report

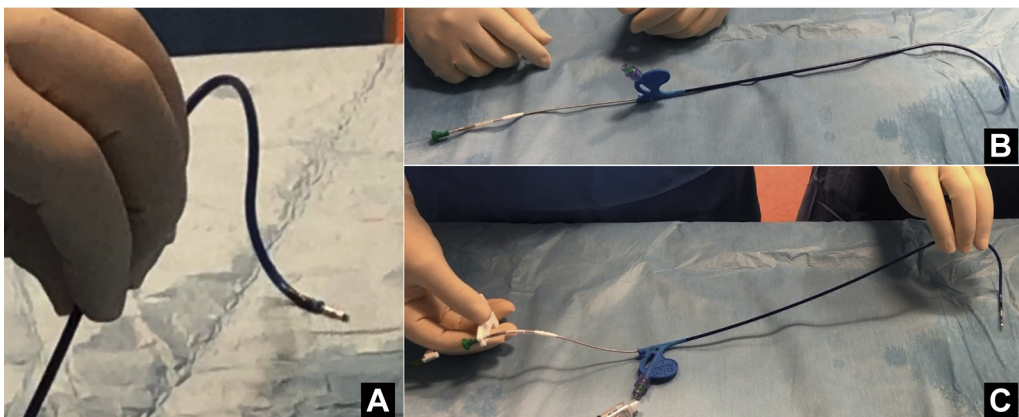
### Case 1

An 86-year-old woman with atrial fibrillation and high ventricular response was referred to our clinic in February 2020 owing to heart failure symptoms. The 12-lead ECG showed atrial fibrillation with 145 beats/min ventricular rate, left axis deviation, and QRS duration 88 ms. Transthoracic echocardiography showed LV ejection fraction 46% and mild mitral regurgitation. Multiple and different

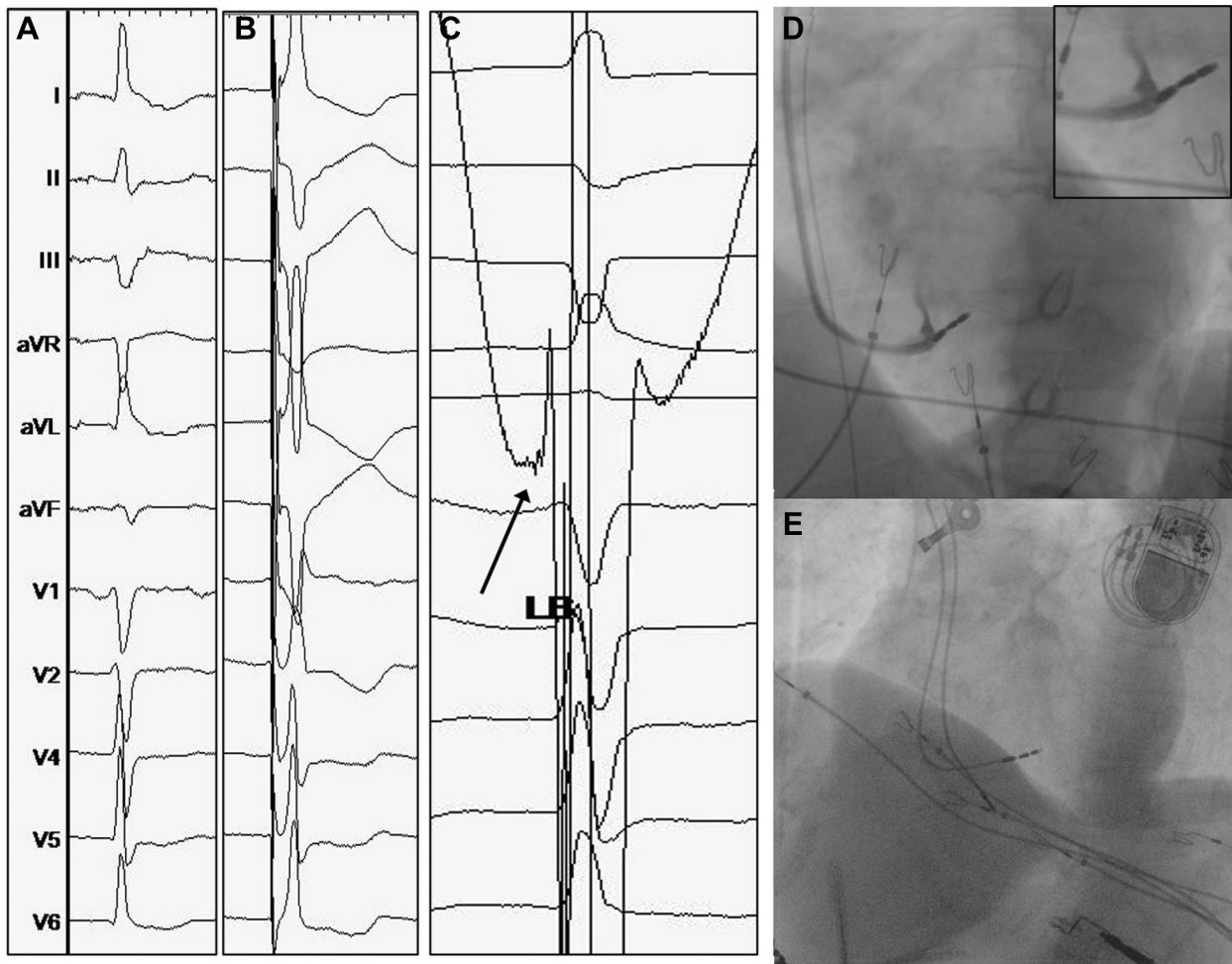
pharmacological strategies were attempted that aimed to reduce the ventricular response (verapamil, metoprolol, amiodarone, digitalis), but without beneficial effects. After 20 days, despite slight clinical improvement, ventricular rate persisted high and consequently the “ablate and pace” strategy was planned. The patient’s informed consent was collected. The new Selectra 3D 55-M curve (Biotronik) was utilized to support the Solia S 60 lead (Biotronik) during mapping of the Hisian area. Owing to high pacing threshold with His pacing, intraseptal LBB pacing was planned. A sharp LB potential was recorded with the LBB-V interval of 16 ms (Figure 2C). The right bundle branch block pattern appeared in lead V<sub>1</sub> when the screw reached the left bundle (Figure 2B). A small injection of iodine contrast (5 mL) confirmed the complete penetration of the tip into the septum with the anode in correspondence of the right aspect of the interventricular septum (Figure 2D). The electrical parameters were as follows: sensing 13 mV, threshold 0.5 V @ 0.4 ms, impedance 554 ohms. However, considering the novelty of the technology, a second lead in the RV apex was implanted as back-up lead (Figure 2E). The LBB lead was connected to the atrial port and the apical lead in the RV port of a dual-chamber pacemaker settled in a DVI mode. After 5 days atrioventricular node ablation was performed, obtaining 100% of ventricular pacing. Paced QRS measured 120 ms (Figure 2B). The 2 procedures were successfully completed without complications. The patient was discharged a few days later, being in good clinical status.

### Case 2

An 81-year-old woman with previous history of hypertension and radiotherapy for breast cancer presented with dyspnea and fatigue after 3 episodes of syncope. Symptoms started 1 month before but owing to the coronavirus disease 2019 (COVID-19) emergency, she initially decided to stay at home, avoiding hospital access. ECG on presentation revealed intermittent episodes of 2:1 atrioventricular block,



**Figure 1** A: The delivery catheter Selectra 3D (Biotronik SE & Co. KG, Berlin, Germany), with a double curve to allow septal positioning; note the standard screw lead exposed at the end of the delivery. B: The standard stylet-driven 6F lead inside the Selectra catheter. C: The standard stylet-driven 6F lead inside the Selectra catheter; note at the tip of the lead the fixation tool to screw the retractable helix.



**Figure 2** Case 1. **A:** Baseline electrocardiogram (ECG) recording of native QRS, speed recording 50 mm/s. **B:** Final unipolar-paced ECG; note right bundle branch pattern in  $V_1$  compatible with QRS morphology of nonselective left bundle branch pacing, sweep speed 50 mm/s. **C:** Electrogram recorded in unipolar fashion from the tip of the lead in the final position showing left bundle (LB) potential (black arrow), sweep speed 100 mm/s. **D:** Left anterior oblique (LAO) fluoroscopic view after injection of small dose of contrast through the delivery catheter showing demarcation of right ventricular septum and the entire dipole lead penetrating the septum (zoomed in the small insert). **E:** Final LAO fluoroscopic view showing the LB lead and back-up lead.

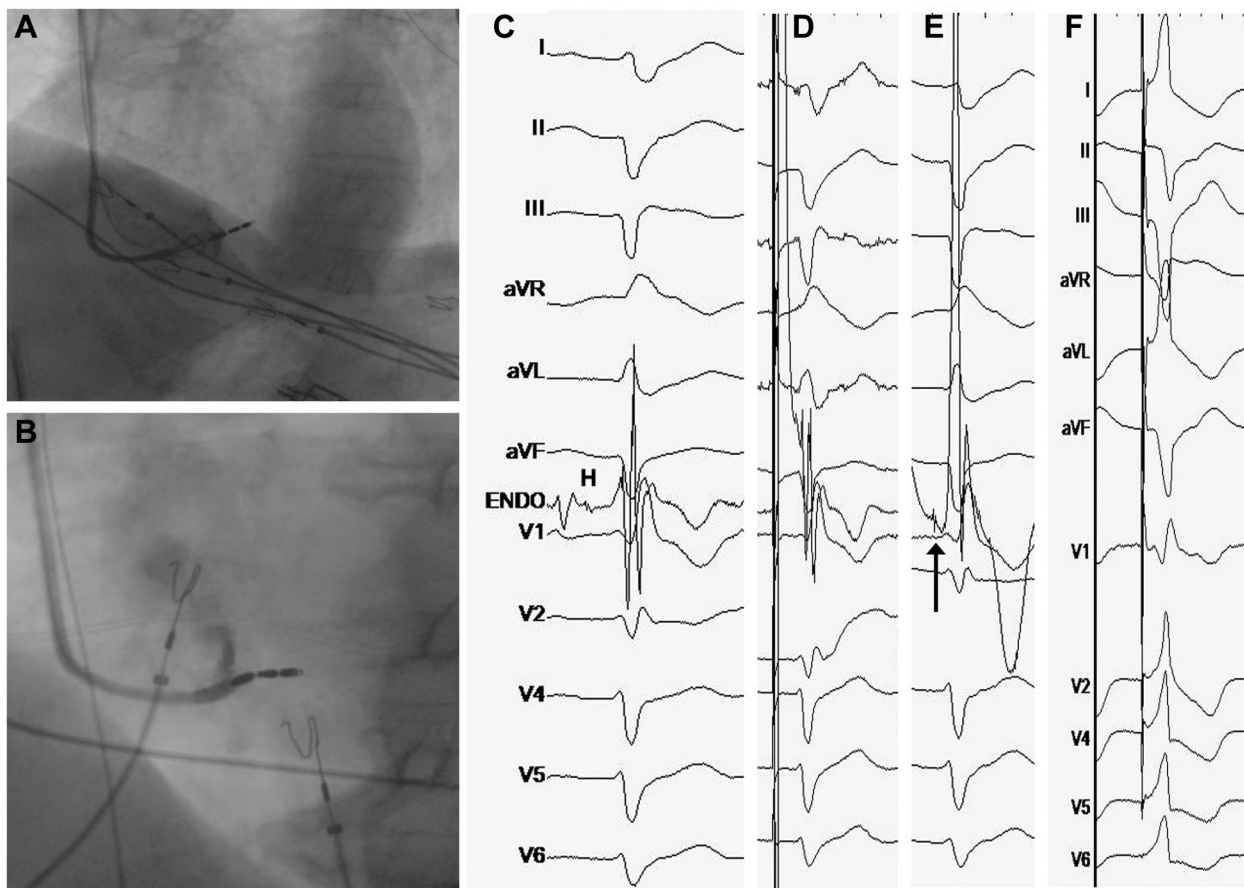
left fascicular anterior block, and QRS duration of 110 ms. Echocardiogram showed LV ejection fraction of 65% and normal values in blood sample. Permanent pacemaker implantation with HBP was attempted. The Selectra 3D 55-M curve (Biotronik) was utilized to support the Solia S 60 lead (Biotronik) during mapping of the Hisian area. HV interval was measured as 100 ms. Both selective and nonselective HBP were obtained but  $>3$  V output was required to capture the His bundle. Finally, after 3 suboptimal attempts, LBB pacing was planned. The lead was successfully screwed into the interventricular septum. R-wave amplitude was 11 mV. Fluoroscopic view of the LBB pacing lead and fulcrum sign<sup>6</sup> are shown in Figure 3.

## Discussion

HBP has emerged as a physiological mode of pacing avoiding the detrimental effect of RV apical pacing. Implant success rate with HBP is high, reaching more than 80%<sup>7</sup>;

however, some possible drawbacks have emerged from this established technique. Pacing thresholds can be higher and sensing slightly lower compared to standard RV pacing, possibly affecting the longevity of devices. LBB pacing is a new and promising technique that, together with HBP, merges in the so-called His-Purkinje conduction system pacing. Although no direct comparison between the 2 pacing sites has been published, LBB pacing seems to have better electrical parameters with high ventricular sensing and low threshold.<sup>6,8</sup> All the published experiences of LBB pacing, until now, have been performed with the Medtronic system, composed of a 3830 4F lead with fixed helix and the fixed-curve sheath (C315 SelectSite). This lead is supposed to have the advantage of the isodiametric shape between the lead body and the helix, facilitating ease of screwing into the ventricular septum. The newly available Selectra 3D delivery sheath (Biotronik) has been designed for positioning the active-fixation Solia S lead (Biotronik) at the His bundle location, and preliminary experiences are ongoing





**Figure 3** Case 2. **A:** Left anterior oblique fluoroscopic view after injection of small dose of contrast through the delivery catheter showing demarcation of right ventricular septum and the entire dipole lead penetrating the septum. **B:** The fulcrum sign, a small angle between the final portion of the lead and the beginning of the dipole. **C:** Baseline electrocardiogram (ECG) recording of native QRS with right bundle branch block and left anterior fascicular block, ENDO depicted His electrogram (H), sweep speed 50 mm/s. **D:** His bundle pacing in unipolar fashion showing selective pacing without conduction disturbance correction, sweep speed 50 mm/s. **E:** Electrogram recorded in unipolar fashion from the tip of the lead in the final position showing left bundle potential (black arrow), sweep speed 50 mm/s. **F:** Final unipolar-paced ECG; note right bundle branch pattern in V<sub>1</sub>, compatible with QRS morphology of nonselective left bundle branch pacing, sweep speed 50 mm/s.

worldwide. The system, composed of the stylet inside the screw lead and a firm delivery catheter, has good stability and support for screwing the lead into the septum. Conversely, the 6F diameter could represent a limit if multiple attempts are required. A possible limitation is represented by the fact that the operator has a very large experience in His pacing. Whereas HBP is an established therapy and many patients have already been implanted all over the world, LBB pacing is a relatively new practice and could not be immediately reproducible on a large scale; but it is a starting point, and future studies are needed to understand the full applicability of this approach with those new tools. In conclusion, the novelty of these 2 case reports is represented by the possibility of pacing the LBB also with a standard stylet-driven lead with a retractable helix coupled with the Selectra 3D introducer.

## References

1. Khurshid S, Epstein AE, Verdino RJ, et al. Incidence and predictors of right ventricular pacing-induced cardiomyopathy. *Heart Rhythm* 2014;11:1619–1625.
2. Vijayaraman P, Chung MK, Dandamudi G, et al. His bundle pacing. *J Am Coll Cardiol* 2018;72:927–947.
3. Huang W, Su L, Wu S, et al. Novel pacing strategy with low and stable output: pacing the left bundle branch immediately beyond the conduction block. *Can J Cardiol* 2017;33:1736.e1–1736.e3.
4. Marcantoni L, Zuin M, Baracca E, et al. Implantation technique of His bundle pacing. *Herzschrittmacherther Elektrophysiol* 2020;31:111–116.
5. Chen X, Wu S, Su L, Su Y, Huang W. The characteristics of the electrocardiogram and the intracardiac electrogram in left bundle branch pacing. *J Cardiovasc Electrophysiol* 2019;30:1096–1101.
6. Huang W, Chen X, Su L, Wu S, Xia X, Vijayaraman P. A beginner's guide to permanent left bundle branch pacing. *Heart Rhythm* 2019;16:1791–1796.
7. Zanon F, Ellenbogen KA, Dandamudi G, et al. Permanent His-bundle pacing: a systematic literature review and meta-analysis. *Europace* 2018;20:1819–1826.
8. Vijayaraman P, Subzposh FA, Naperkowski A, et al. Prospective evaluation of feasibility and electrophysiologic and echocardiographic characteristics of left bundle branch area pacing. *Heart Rhythm* 2019;16:1774–1782.