HANDS ON

How to perform permanent His bundle pacing in routine clinical practice

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Over the years, various sites of ventricular pacing have been evaluated in clinical trials. Earlier trials established the detrimental effects of right ventricular (RV) apical pacing, including increased risk of atrial fibrillation, heart failure (HF), and mortality. Alternate RV pacing sites have yielded mixed results.[1] Biventricular (BiV) pacing in advanced HF and electrical dyssynchrony reduced HF hospitalizations and mortality. Recently, 2 trials evaluated the clinical utility of BiV pacing in the setting of heart block and demonstrated equivocal results.[2,3] The biventricular pacing for atrio-ventricular block and systolic dysfunction (BLOCK-HF) trial showed benefits of BiV over RV pacing, mostly driven by change in left ventricular (LV) systolic volumes. Preliminary results of the biventricular pacing for atrio-ventricular block to prevent cardiac desynchronization (BioPace) trial showed no significant clinical benefit of BiV over RV pacing. There still remains an unmet need in populations with first-degree heart block and HF, populations with right bundle branch (RBB) block (Online Supplemental Figure 1) and HF, and cardiac resynchronization therapy nonresponders (Online Supplemental Figures 2 and 3), where A-V and V-V synchrony may improve outcomes.

Clinical permanent His bundle pacing (PHBP) was first described in 2000.[4] Since then, several investigators[5–8] across the world have published the safety and feasibility of PHBP. We attempt PHBP in all patients with indication for permanent pacemaker implantation and have performed more than 500 implants in past 5 years (success rate of 85% in recruiting the His bundle [HB]). We have performed PHBP in more than 100 patients with heart block (atrioventricular nodal block and intra-His heart block) (Online Supplemental Figure 4).[7] Benefits include ability to achieve physiological pacing by recruiting the native His Purkinje system and avoiding electrical dyssynchrony, potentially translating into reduced HF incidence.[8] The anatomy of the HB has been well characterized.[9] Also, limited clinical observations have demonstrated that the lead does not cross the tricuspid valve and this may result in lower incidence of valvular regurgitation.[10] We describe our method of performing PHBP along with potential device/lead issues that one may encounter at the time of implantation and during follow-up. Most of these issues can be successfully addressed with appropriate programming.

KEYWORDS Permanent His bundle pacing; Electrical synchrony; Selective His bundle pacing; Nonselective His bundle pacing; AV block (Heart Rhythm 2016;13:1362–1366)

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Equipment requirements

Following are the equipment requirements:

1. Medtronic (Minneapolis, MN) 3830 69-cm His lead with a 1.8-mm exposed helix, lead outer diameter (OD) 4.2F (Figure 1A). It is a solid core pacing lead with no central lumen to deliver a stylet, requiring a long sheath for delivery.
2. Medtronic C315 His nondeflectable sheath (43 cm), inner diameter (ID) 5.5F, OD 7.0F (see asterisk in Figure 1B), primary curve to reach the superior aspect of the tricuspid annulus, secondary curve to reach the septum. A Medtronic deflectable sheath (C304-69; ID 5.7F and OD 8.4F) is also available with unidirectional deflection (Figure 1C); it can be helpful in challenging anatomical situations (dilated right atrium [RA], an inferiorly displaced HB, etc.).
3. Short 7F peel-away sheath to place the C315 His sheath through it. It allows continued vascular access after the His sheath is split (guidewire can be retained as well).
4. Pace-sense analyzer (PSA) to record intracardiac electrograms (EGMs). Because of the inherent sensing algorithms built into the Medtronic PSA, we usually connect the pacing lead to the atrial channel (higher gain setting of 0.05 mV/mm). For PSAs of other manufacturers, the lead can be connected to the ventricular channel.
5. Unipolar connection to map the HB EGMs with the pacing lead. We use the pacing lead to map the HB with PSA EGMs, without the need for a mapping catheter. Also, an electrophysiology (EP) recording system can be used (PSA EGMs are adequate).
6. Twelve-lead electrocardiogram for the procedure (critical to analyze pacing morphologies to confirm recruitment of the HB).

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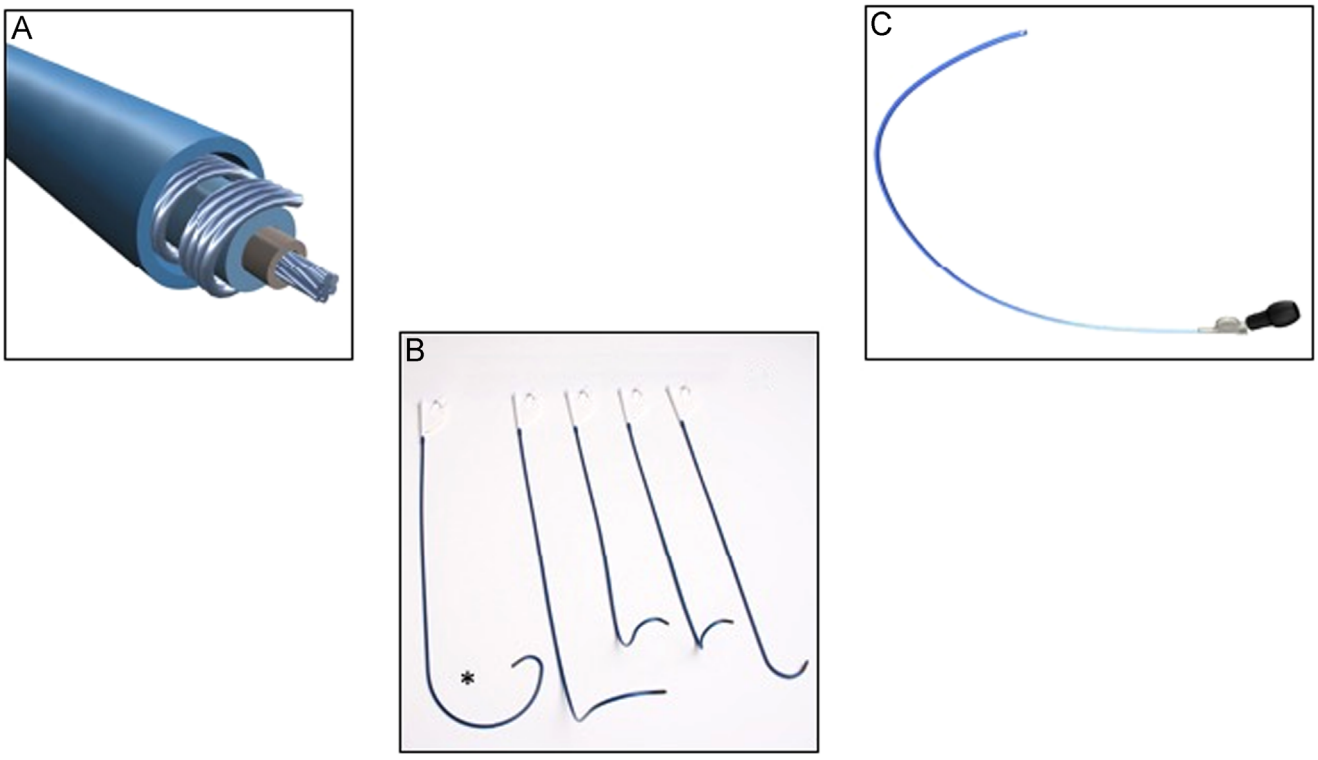

Figure 1 **A**: Select Secure 3830 lead. **B:** Several nondeflectable sheaths used for the 3830 lead. The first sheath marked by the asterisk is a C315 His nondeflectable sheath used for His bundle mapping and lead placement. All other sheaths are used for either right atrial or right ventricular lead placement. **C:** Deflectable sheath used occasionally to place the His bundle lead (Medtronic, Inc.).

Procedure description

Once vascular access is obtained (cephalic, axillary, or subclavian vein), a guidewire is advanced into the RA or RV (see Online Supplemental Movie). A short 7F sheath can be advanced over the wire to retain access. Otherwise, the C315 His sheath is advanced into the RA or RV and the guidewire removed. The pacing lead is advanced to the tip of the sheath, with the distal tip of the lead exposed minimally. Unipolar connections are made with the tip of the lead and cardiac tissue.

If the sheath and the lead tip are in the RV, the apparatus is gently pulled back to the atrioventricular grove with minimal counterclockwise rotation to ensure that the lead tip is abutting the septum. If the sheath and the lead are in the RA, gentle forward clockwise rotation tends to move the apparatus to the summit of the tricuspid annulus.

While this is being performed, it is important for both the operator and the person operating the PSA to pay careful attention to intracardiac EGMs. Small movements are encouraged as HB deflections can be easily missed. We usually set the sweep speed to 50 or 100 mm/s to allow better separation of atrial, HB, and local ventricular EGMs.

Once HB EGMs are obtained, unipolar pacing is performed since the proximal pole of the lead is within the sheath. We start pacing at 5 V @ 1 ms and assess 12-lead QRS morphologies. The following patterns can be observed:

1. Pure HB pacing where stimulus to ventricular activation is equal to the intrinsic HV interval and paced QRS morphology is identical to the intrinsic QRS complex. We term this as *selective HB pacing* (Figures 2 and 3).
2. HB capture with local ventricular fusion: stimulus-ventricular capture is shorter than the HV interval. The pacing output is decremented to assess the changing QRS morphologies (akin to para-His pacing performed to assess septal accessory pathways). We term this as *nonselective HB pacing* (Figures 2 and 3). Various responses can be observed:

(a) At high output, the HB is preferentially recruited with progressive widening as output is reduced, resulting in more local ventricular capture.

(b) At high output, more fusion is encountered because of local ventricular capture, and at lower output, HB is preferentially activated, resulting in less fusion (Figures 2 and 3).

(c) Sometimes just before loss of capture, pure HB pacing can be seen. Also, selective RBB or left bundle branch (LBB) capture can be demonstrated (Figure 3).

(d) Sometimes because of the proximity of RBB and more ventricular placement of the lead, RBB capture can occur. This results in an LBB block pattern-wide QRS complex. It may be difficult to determine whether local myocardial capture occurs along with RBB capture. If intrinsic conduction is present, measuring the HV interval can help determine RBB capture. Typically, a local HV interval would be short (<30 ms), with no far-field atrial EGM seen on the PSA.