

Editorial Article**To Pace or Not To Pace The His Bundle**Vanita Arora\*, Pawan Suri<sup>1</sup>

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Cardiac pacing has evolved considerably over the years from its initial introduction as a lifesaving measure by asynchronous ventricular pacing (VVI) to atrioventricular (AV) synchronous (DDD) and finally Biventricular pacing or Cardiac Resynchronization Therapy (CRT). Traditionally, right ventricle apical (RVA) pacing has been pursued successfully for decades and the deleterious consequences in form of impaired myocardial perfusion, mitral and tricuspid insufficiency, increased risk of atrial fibrillation and systolic dysfunction due to electrical and mechanical ventricular dyssynchrony has remained unaltered. Although there remains debate regarding the optimal pacing site for both clinical and hemodynamic outcomes, the various alternate pacing sites including the septum, outflow tract and left ventricle have been tried with modest, but significant, hemodynamic benefit over RVA pacing, yet the data regarding an advantage in exercise capacity, functional class, quality of life or survival is limited and inconclusive. There exists a need for new pacing techniques that could reduce intraventricular and atrioventricular dyssynchrony by providing a more physiological pattern of ventricular electrical activation, to maintain the contractile function, optimizing atrioventricular synchrony and reducing the clinical complications of a high burden of RV pacing.

Permanent His bundle pacing is an emerging technique to deliver a more physiological pattern of ventricular pacing and has the potential to mitigate the adverse consequences of chronic right ventricular pacing and promote atrioventricular and intraventricular synchrony. His bundle lies within the membranous portion of the interventricular septum and is surrounded by the fibrous connective tissue rather than the myocardium. Delivering electrical stimulation at or adjacent to the His bundle leads to either selective capture (in which only the His bundle is stimulated, also known as S-HBP) or nonselective capture (in which fusion capture between the His bundle and adjacent ventricular tissue occurs, leading to a preexcitation-like pattern, also known as NS-HBP).

Although HBP was first reported by Scherlag et al in 1967, the first significant clinical series in humans was not published until 2000 by Deshmukh et al. Despite that, HBP did not receive much attention until more recently and is now emerging as a promising modality to preserve synchronous ventricular pacing. Many studies have shown that HBP is feasible, safe, and offers a better outcome for left ventricular end-diastolic and end-systolic diameters, systolic function, shorter interventricular electromechanical delay, improvement in the quality of life, reduction in NYHA class and improvement in the 6-min walk when compared with RV pacing. One further potential advantage of HBP compared with RVP is a theoretical reduction in the risk of functional tricuspid regurgitation when the lead position lies on the atrial side of the tricuspid valve (as is the case in many His bundle implants).

The observation of HBP leading to the restoration of narrow QRS in patients with bundle branch block (electrical resynchronization) has generated interest as to whether this could induce mechanical resynchronization and replace traditional CRT. The mechanism for the reduction in QRS duration with HBP

includes recruitment of fibers distal to the site of delay, longitudinal dissociation, capture attributable to higher pacing outputs, and hyperpolarizing dormant His bundle tissue and the feasibility of HBP in CRT indicated patients were reported by Lustgarten et al in 2010.

HBP is technically a challenging procedure. However, results from high volume implanting centers suggest that success rates improve progressively with operator experience. This has been helped by the custom made delivery sheaths, lumen less lead (Medtronic 3830 4Fr lead), although the need for an even better implanting tool remains. The implant success rates in attempted HBP from studies that published the denominator number from which successful HBP was achieved varies from 56-95%, with most recent studies showing improvement in implant

success rates of as high as 80–90% with enhanced implanter experience. The learning curve is approximately 40 cases and maybe more for device specialists who do not perform electrophysiological studies and are not accustomed to locating His or interpreting endocavitary signals. If an electrophysiological bay is not available, a pulse sense analyzer needs to be used, which is sub-optimal.

Most studies in the field of HBP have been case series with rare exceptions, therefore, there is a need for randomized controlled trials in this field before very firm recommendations can be made with a certain degree of comfort in future pacing guidelines. However, in the 2018 American College of Cardiology/American Heart Association/Heart Rhythm Society guidelines on the evaluation of patients with bradycardia and cardiac conduction delay, HBP or BiV pacing is a class IIa indication over right ventricular pacing in patients who have an LVEF 36–50% and who are expected to be paced in the ventricle during >40% of the time. HBP is a class IIb indication in patients who have an atrioventricular block at the nodal level (as opposed to the infra-nodal level) and who have an indication for permanent pacing, to maintain physiological ventricular activation.

Other possible indications, which are currently not in guidelines, are patients who require an ‘ablate and pace’ strategy for rapidly-conducted atrial arrhythmias, although ablation of the atrioventricular node may be challenging to avoid compromising the function of the His lead. In patients with failed coronary sinus lead implantation or case of non-response to BiV pacing, HBP may be an alternative. Another consideration is in patients with chronic atrial fibrillation who indicate CRT. A His lead may be connected to the atrial port (instead of plugging it), which provides the option of delivering either HBP, BiV pacing, or His-optimised CRT (HOT-CRT; i.e. HBP in conjunction with right ventricular/left ventricular/BiV pacing).

One current major barrier to the more widespread uptake of HBP is that successful implantation with an adequate capture threshold is more technically challenging than RVP because of the much smaller potential target area for lead placement. A further disadvantage of HBP is that higher pacemaker energies tend to be needed to achieve His bundle capture given a higher threshold compared with RV capture, which may cause more rapid battery depletion.

Other challenges at implant include failure to map the His Bundle, failure to capture the His bundle, as well as lower R-wave amplitudes and high pacing thresholds when compared with RV pacing. Low R-wave amplitude might raise safety concerns about the ability to sense ventricular arrhythmias, while high pacing thresholds may adversely affect device longevity. The concern

remains about the proximal conduction disease progressing to infra- Hisian block in HBP patients and also in high degree AV block where placing a backup RV lead might be required. Long term performance of the commercially available specialized HBP lead in RCT has not been done as yet. There is no reported experience with the extraction of HBP lead. Extraction of small caliber, fixed screw leads can by itself be challenging, but with peculiar designed non-stylet HBP lead, the outcome of extraction remains unknown for now.

We are currently experiencing an exciting era with the advent of HBP, which allows us to offer true physiological pacing to our patients. The field is evolving rapidly, but more evidence from randomized controlled trials is required before it can replace right ventricular pacing (and even more so, BiV pacing, HOPE-HF trial) in routine practice. Furthermore, tools and technology need to evolve to facilitate adoption. As expertise with implantation is becoming more widespread, we are soon likely to witness the launching of large multicentre studies, which will hopefully provide the evidence we need to dispel any doubts regarding the benefit of this therapy.

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