Septal and Conduction System Pacing

Demosthenes G Katritsis[1,2] and Hugh Calkins[2]

1. Hygeia Hospital, Athens, Greece; 2. Johns Hopkins Hospital, Baltimore, MD, US

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Correspondence: Demosthenes Katritsis, Hygeia Hospital, 4 Erythrou Stavrou St, Athens 15123, Greece. E: dkatrits@dgkatritsis.gr

Specific conduction system pacing is a recent development in efforts to restore normal electrical conduction in the heart by means of artificial pacing.[1] It can be achieved by specific His or left bundle branch (LBB) pacing and, possibly, by non-specific high right ventricular (RV) septal pacing. There are several clinical situations in which conduction pacing is clearly indicated.

Abnormal conduction-induced cardiomyopathy refers to left ventricular (LV) systolic dysfunction caused by high-burden, apical right ventricular pacing, LBB block (LBBB) or pre-excitation.[2–5]

The deleterious effects of RV apical pacing in particular are now well established, and RV septal pacing, by means of intraventricular synchrony and LV function, is beneficial.[6,7] There is an increased risk of pacing-induced heart failure (HF), particularly during the first 30 and 180 days after implantation; randomised comparisons that showed septal had no benefit over apical pacing were limited by a relatively short-term follow-up and uncertainty about the precise position of the septal pacing lead.[5,8–10]

Mechanical dyssynchrony – nonsynchronous contraction of the wall segments of the left ventricle (intraventricular) or between the left and right ventricles (interventricular) – impairs systolic function and ventricular filling, increases wall stress and worsens mitral regurgitation. It is most readily identified by the presence of QRS widening and LBBB configuration on the electrocardiogram, or intraventricular conduction delay and a QRS duration of ≥150 ms even in the absence of LBBB.[11]

Biventricular pacing by atrial-synchronised pacing of the RV and the LV via the coronary sinus to the basal or midventricular LV region accomplishes reverse remodelling of the LV, and had been considered the gold standard for cardiac resynchronisation therapy (CRT) in patients with heart failure.[12]

CRT may even eliminate the need for an ICD in patients with LV systolic dysfunction, especially in patients with non-ischaemic cardiomyopathy.[13–18] However, approximately 30%–35% of patients are nonresponders in whom CRT fails to result in benefit despite appropriate indications for this therapy.[19,20]

Specific His bundle pacing offers comparable or better results than biventricular pacing by means of cardiac resynchronisation.[21–23] In the LBBP-RESYNC randomised controlled trial, LBB pacing-CRT was demonstrated to result in greater improvement in LV ejection fraction (LVEF) than biventricular pacing-CRT in HF patients with nonischaemic cardiomyopathy and LBBB.[24,25]

In patients with AF in whom drug or pulmonary vein ablation therapy has failed or who have signs of tachycardiopathy, atrioventricular (AV) nodal catheter ablation or modification followed by ventricular or biventricular pacing may be necessary.[26] Biventricular pacing if LVEF ≤35% is superior to apical RV pacing in these patients, as it is for those who need permanent pacing for AV block where LVEF <50%.7.[27–29] However, in a systematic review for the 2018 American College of Cardiology/American Heart Association/Heart Rhythm Society guideline on bradycardia, among patients with LVEF >35%, LVEF was preserved or increased with either biventricular or His-bundle pacing compared with right ventricular pacing, but improvements in patient-centred clinical outcomes appeared to be limited primarily to those with chronic AF with rapid ventricular response rates who had undergone AV node ablation.[30]

LBB pacing has also improved LVEF, with a higher implant success rate and fewer late lead-related complications than His bundle pacing in patients with AF and HF after AV junction ablation.[31]

Biventricular pacing, therefore, is an attractive option in many clinical situations. However, it is a cumbersome procedure, and the potential for LV lead-related complications as well as an increased QT interval should be also considered.[32]

Specific conduction system pacing is emerging as a new option, potentially associated with improved clinical outcomes and fewer complications.

Potential problems with His-bundle pacing are higher pacing thresholds, lower R-wave amplitudes and the potential to develop distal conduction block. The potential need for a backup ventricular lead has been raised.[33]

LBB pacing has emerged as an alternative method for delivering physiological pacing to achieve electrical synchrony of the left ventricle, especially in patients with infranodal AV block and LBBB.[34,35] Selective LBB pacing is indicated by a discrete electrogram in the LBBP lead and either an M or rsR' and wide R' with a notch in lead V1, and a discrete component between stimulus and ventricle activation in paced electrogram.[35,36] Non-selective LBB pacing has a narrower right bundle branch block morphology than selective LBBB pacing (as opposed to selective and non-selective His-bundle pacing) and without the discrete pattern.

Theoretically, LBB pacing leads to a more synchronous activation of the left ventricle than non-selective septal pacing due to capture of the specialised conduction system. However, the procedure may be cumbersome, and septal perforation should be considered when pacing parameters are suboptimal and treated by reimplantation.[37]

High RV septal pacing is also theoretically beneficial, at least in patients with no previous anteroseptal MI. Preliminary animal and human studies have indicated that both selective LBBB and non-selective septal pacing strategies seem to maintain electrical and mechanical activation of the left ventricle to a near physiologic level.[38] Should this prove to be true in clinical studies, a new era for a simplified approach, with straightforward septal pacing of the RV, either with a lead or through a directly implanted pacemaker, will emerge.

The approach may not achieve the precise conduction system excitation offered by specific His or LBBB pacing, but it is considerably easier to perform and avoids complications that are inherent to specific pacing modes.[39] We are certainly entering a new era of cardiac pacing. ❑

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