Individual long-term response

Permanent His bundle pacing – a valid alternative to biventricular cardiac resynchronisation therapy?

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Summary

Cardiac resynchronisation therapy (CRT) using biventricular pacing has become standard of care for patients with symptomatic heart failure, wide QRS and left ventricular ejection fraction (LVEF) <35% refractory to optimal medical treatment. Convincing data have demonstrated improvement in quality of life as well as mortality rates in CRT responders. However, individual long-term response is difficult to predict as demonstrated by the usual 25–30% rate of non-response.Permanent His bundle pacing has emerged as an alternative to biventricular pacing to deliver physiological pacing as well as cardiac resynchronisation.We are presenting the case of a 78-year-old patient in whom resynchronisation using His bundle pacing translated into a clearly superior acute electrical result compared with biventricular pacing.

Case description

A 78-year-old male patient who had undergone repeated ablations in our centre for atrial arrhythmia presented with recurrent atrial fibrillation complicated by a tachy-cardiomyopathy despite optimised rate control medication. The baseline ECG showed a normal QRS with duration of 120 ms (see fig. 2) and the left ventricular function was severely reduced (left ventricular ejection fraction [LVEF] 16%). In line with the current American Heart Association (AHA) guidelines (expected pacing rate >40%), atrioventricular node ablation and physiological pacing was proposed to our patient.

Via a left subclavian venous access, a right ventricular shock lead (Medtronic, Sprint Quattro Secure S MRI SureScan 6935M- 62 cm) as well as a quadripolar left ventricular lead (Medtronic, Attain Stability 88 cm) were implanted. The latter was successfully positioned in a posterolateral coronary sinus side branch (fig. 1). Intrinsic left ventricular delay (QLV) was 114 ms with a promising high QLV/QRSd ratio of 0.95. Symmetrical paced-to-sensed delays (RVp-LVs = LVp-RVs = 120 ms) indicated bidirectional homogeneous ventricular activation. However, the acute electrical result of biventricular pacing was disappointing, with a broad QRS of 156 ms (fig. 2) despite an optimised pacing configuration.

Therefore, we decided to attempt more physiological ventricular activation by pacing the bundle of His. Using the preshaped C315 His Sheath (Medtronic, Inc. MN) and the non-stylet-driven, exposed-helical screw SelectSecure lead (Medtronic, Inc. MN), His mapping (HV interval 68 ms) and recruitment were easily obtained with relatively low thresholds (1.3 V/1 ms and 0.4 V/1 ms for non-selective and selective capture, respectively). Ventricular depolarisation during selective His bundle capture was clearly faster and more homogenous, as evidenced by the paced QRS morphology and duration (116 ms) (fig. 2). The lead was fixed and connected to the atrial port of the cardiac resynchronisation therapy-defibrillator (CRT-D) device (Medtronic, CLARIA MRI Quad CRT-D sure scan), which was reprogrammed in AAI-DDD mode. Atrioventricular node ablation was scheduled 6 weeks later and resulted in complete resolution of the patient's symptoms and improvement of the LVEF to 36% at 6-month follow-up. The thresholds remained stable with a selective capture threshold at 0.5 V/1 ms at 6-month follow-up.

Discussion

Either biventricular pacing or His bundle pacing can achieve physiological pacing. In both situations, acute QRS duration might indicate the probability of reverse remodelling and long-term response. Clinical benefits are restricted to patients who demonstrate at least a rapid homogeneous electrical ventricular activation as attested by a relatively short paced QRS duration. Usually this occurs with biventricular pacing when the left ventricular lead is positioned at the region of

Published online first – please cite as: Cardiovasc Med. 2022;25:w10117. doi: 10.4414/cvm.2022.w10117 EMH Media

the latest electrical activation, which can be validated by a long QLV, QLV/QRS ratio and inter-lead electrical distance [1]. Although these requirements were sufficiently met in our case, the resulting QRS during biventricular pacing was disappointing (relative QRS prolongation of 30%). In a patient with a narrow baseline QRS, the electrical synchronisation will naturally worsen if the initiated pacing captures only myocardium distant from healthy conduction tissue. Attempts should be made to preserve native conduction as far as possible. Accordingly, we added a His bundle pacing lead to the system, which resulted in much more physiological biventricular activation and QRS morphology.

The feasibility of His bundle pacing has been studied and demonstrated since the year 2000. In 2019, the His-SYNC trial was the first randomised study directly comparing His bundle pacing with biventricular pacing for CRT [2]. A greater narrowing of the QRS was shown with His bundle pacing with a trend towards greater echocardiographic improvement after 6 months. The recent HOT trial [3] studied an even more advanced approach for physiological pacing. In patients referred for CRT, His bundle pacing was attempted in addition to left ventricular pacing. A greater electrocardiographic response was seen when patients could be paced sequentially from the His lead and biventricularly, with 84% of patients being clinical responders after 14 months. Despite these promising results, large randomised trials comparing different physiological pacing strategies are lacking. His bundle pacing might however be considered for a broad variety of indications and even as a general alternative to conventional right ventricular pacing as the more synchronous ventricular activation might overcome pacing induced cardiomyopathy.

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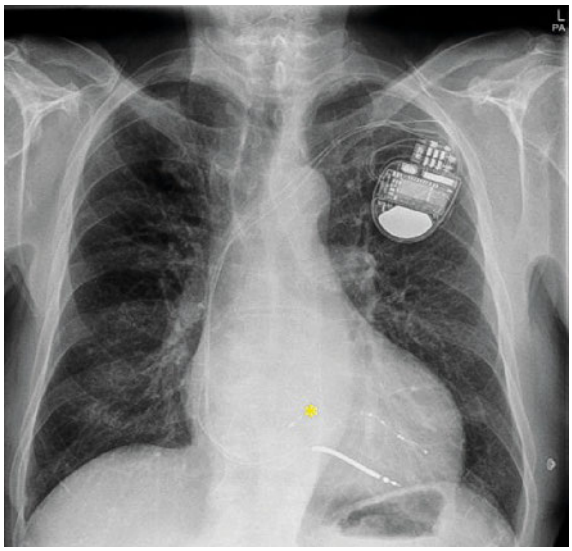

Figure 1: Chest x-ray in postero-anterior view. Ccardiac resynchronisation therapy-defibrillator device with right ventricular shock lead, quadripolar lead in a posterolateral side branch of the coronary sinus and His pacing lead (yellow asterix).

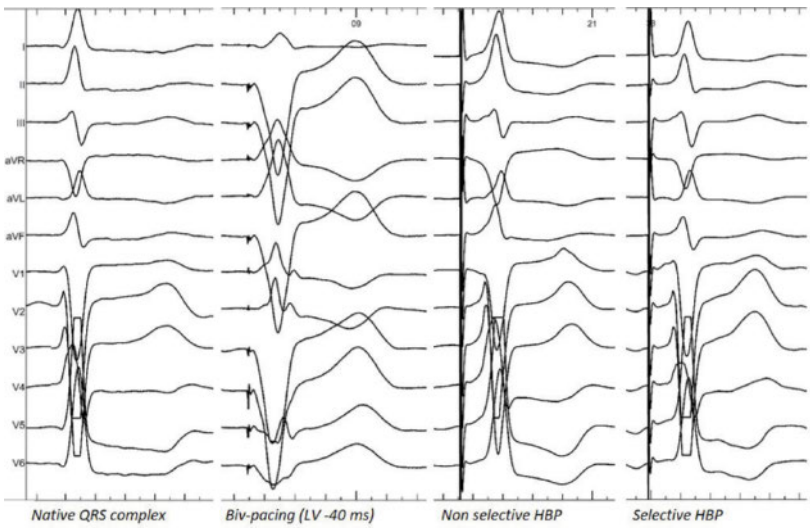

Figure 2: Surface ECGs speed 100mm/s.

The use of His bundle pacing is now endorsed in the latest 2021 ESC guidelines for CRT candidates in whom coronary sinus lead implantation is unsuccessful and for patients with narrow QRS complex in whom an atrioventricular node ablation is scheduled, as in our case [4]. Data about the long-term course of these patients is insufficient to determine who additionally needs a conventional right ventricular lead as "back up" in case of a future, more distal conduction tissue block. Accordingly, it is so far recommended by the guidelines in patients with pacemaker dependency and in case of issues with the His lead sensing.

Interestingly, resumption of physiological electrical activation by His bundle pacing can also be achieved in patients with baseline bundle branch block. The most postulated pathophysiological explanation lies in the anatomical properties of the His bundle. A longitudinal dissociation of the fibres allows recruitment of the left or right bundle branch distal to the level of block within the His bundle, resulting in complete bundle branch block correction. An alternative approach to engage native conduction tissue is left bundle branch

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area pacing (LBBAP). For this more recent method, an electrode is screwed transseptally to directly stimulate the left septal conduction system. There are currently no devices with a dedicated His pacing port available. A recent review has nicely summarised the options for the programming, which requires adaptions in the individual case according to reason for pacing as well as number and location of electrodes [5]. In our case, we used the atrial port of the CRT generator for the His lead. The atrioventricular interval was programmed to a value slightly higher than the measured HV interval. In AAI-DDD mode it functions therefore as a VVI system with His pacing. To avoid confusion with the His lead in the atrial port, we deactivated the dual-chamber rhythm discrimination. In patients with an atrial lead, it would be feasible to connect the His lead to the right or or left ventricular port with the atrial and left or right ventricular lead, respectively, in the corresponding ports [5].

In this case, selective His bundle pacing could be achieved at a low pacing output, comparable to conventional pacing, and demonstrated its great potential as first line pacing modality.

Further investigation addressing the safety of long-term pacing with a His lead only as well as determination of optimal physiological pacing strategy is ongoing. In our case however, selective His bundle pacing could be achieved at a low pacing output, comparable to conventional pacing, and demonstrated its great potential as first line pacing modality. While aiming for further robust data, we consider His bundle pacing a valid and promising option to reach optimal physiological pacing.

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Disclosure statement
No financial support and no other potential conflict of interest relevant to this article was reported.

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