HIS BUNDLE PACING, THE FIRST EXPERIENCE USING A CONVENTIONAL PACEMAKER LEADS

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Submitted: 14/9/2019; Accepted: 13/29/2020; Published: 21/9/2020

ABSTRACT

Background

The classical pacing site at the right ventricular apex has been noticed to induce left ventricular function deterioration and heart failure over long pacing periods. Trials of right ventricular outflow tract pacing have been reported to reduce this problem in a few patients.

Objectives

His bundle pacing has been lately found to minimize pacing-induced cardiomyopathy significantly.

Materials and Methods

Patients included are those with high degree heart block, who needed conventional pacing and those with an indication for cardiac resynchronization therapy where His bundle pacing was done as a substitute to a failed coronary sinus lead positioning for left ventricular epicardial pacing. His Bundle Pacing was done by blind His pacing site assessment through continuous ventricular pacing at the presumed His bundle site under fluoroscopy views. The leads used are conventional pacing leads. His bundle pacing was indicated by almost normal width paced QRS.

Results

His bundle pacing was successful in 30 patients from a total of 45 referred patients (67%). Fifteen patients with second or third-degree heart block who needed conventional pacing and 15 patients with an indication for cardiac resynchronization therapy, where His bundle pacing was done as a substitute to a failed coronary sinus lead positioning for left ventricular epicardial pacing. The 15 patients with high grades atrioventricular block did not show evidence of heart failure and dilated cardiomyopathy. The 15 patients with cardiac resynchronization therapy indication showed marked narrowing of the paced QRS, improvement in NYHA functional class, significant improvement of left ventricular ejection fraction, and reduction of cardiac size.

Conclusion

His bundle pacing is more physiological than right ventricular apical pacing and right ventricular outflow pacing as far as narrowing of the paced QRS, left ventricular function stability, and reduced incidence of pacing-induced cardiomyopathy. It is recommended in all conventional pacing indication. Whether patients with atrioventricular block or in cardiac resynchronization therapy indication when coronary sinus/left ventricular lead failed. Future availability of special leads and delivery system, improvement in leads, the design and positioning techniques at the His site may well improve the success rate of His bundle pacing and may replace left ventricular epicardial pacing in cardiac re synchronization therapy.

Keywords: *His pacing, Conventional pacemaker leads.*

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https://doi.org/10.17656/jsmc.10262

INTRODUCTION

Cardiac pacing is traditionally done through the right ventricular apex (RVA), this has been shown to induce a type of cardiomyopathy labeled as right ventricular pacing-induced dilated cardiomyopathy (RV - PICM) [1, 2]. It is associated with a higher incidence of long term heart failure (HF), increased hospital admission, higher incidence of atrial fibrillation, and increased mortality [3,4,5,6]. The mechanism of this condition is proposed due to pacing-induced ventricular dyssynchrony [5]. Finding an alternative to RVA pacing has been the interest of many trials hoping for more physiological pacing site like right ventricular outflow tract (RVOT) and septal pacing [7, 5, 8]. His bundle pacing (HBP) or para-Hisian is a physiological alternative to right ventricular (RV) pacing which is associated with much less endpoint of mortality and heart failure hospital admission [5, 9, 10, 11, 12]. Direct HBP reproducing native physiological ventricular activation was first described by Scherlag et al in 1967 in open surgery dogs utilizing plunge electrodes [13]. In clinical practice, HBP was first described by Deshmukh et al in 2000 in patients with atrial fibrillation (AF) undergoing atrioventricular nodal ablation [14]. Over the next decade after Deshmukh several investigators reproduced the clinical feasibility of permanent HBP [11, 15-17].

Comparing HBP to RVA pacing has shown a much better outcome with HBP regarding the incidence of HF, hospital admission, and all-cause mortality [11, 17, 18]. The technique of performing HBP is challenging and almost needs special leads and delivery system which include: Medtronic Select Secure 3830-69cm His lead and a Medtronic C315 His non-deflectable or more recently deflectable sheath [10]. These equipment required are not always available and much more expensive than conventional pacing leads and peel away sheaths. Using the conventional equipment for HBP is a great challenge to the operator and needs a better-refined technique and a good understanding of the anatomy of the His bundle. In this study, HBP has been used in both conventional pacings for high grades atrioventricular block (AVB) and HF patients with an indication for cardiac resynchronization therapy (CRT) when coronary sinus (CS) cannulation or stabilising epicardial left ventricular (LV) leads fail [9,18]. The efficacy of HBP as an alternative to epicardial LV pacing in CRT has been studied and shown to be associated with significant narrowing of QRS duration and improvement in LV function in patients with RBBB or classical LBBB [5, 17-19].

In this paper, we describe our first experience with HBP using conventional pacing leads and standard peel away sheaths.

PATIENTS AND METHODS

The selected 45 patients for HBP from referred patients with high grades AVB needing dual or single chamber pacemaker or HF patients referred for CRT. The selection criteria are a AVB associated heart failure. b, previous RVA pacing caused RV perforation. c, failure of CS cannulation in CRT indication or improper, unstable, or failed positioning of epicardial LV lead due to CS venous anomalies. The HBP was done through our bifocal RV pacing program as an alternative to CS/ LV leads in CRT or with intentional HBP with backup RVA lead.

The technique used for HBP almost depended on anatomical views for presumed His bundle position and obtaining a narrow QRS during continuous ventricular pacing while trying to obtain His bundle site pacing. The initial experience came from our trial of bifocal RV pacing including RVA and RVOT pacing in failed cases of LV / CS lead introduction in CRT indication. We got significantly narrow QRS in some bifocal RV pacing, but with abolishing the apical pacing and relying mainly on the RVOT pacing we noticed significantly narrow QRS by this site of RV pacing. Looking at Dr. Mond's RVOT pacing sites we realized that what was called the "sweet spot" of the RVOT pacing is a parahisian pacing through the high RV septal site[7]. Accordingly, we applied this parahisian pacing to patients with high grades AVB associated heart failure and then in patients without heart failure after gaining reasonable experience with HBP.

The leads used are all conventional standard active fixation leads including CapsureFix Novus from Medtronic (Medtronic, Minnesota, USA), Tandril from SJM (Abbott) (SJM/Abbott, Chicago, USA), Flextend from Boston Scientific (BS, Marlborough, Massachusetts, USA) and Selox JT from Biotronic (Biotronic, Berlin, Germany). The leads are introduced through standard peel away sheaths from the above-mentioned manufacturer with the suitable sizes for the concerning leads. In 24 patients left single, dual or triple subclavian vein puncture was done and two or three guide wires used to lead the peel-away sheaths and introducing the pacing leads through. In six patients cephalic vein was exposed after difficult and failed subclavian vein puncture and the two RV leads and the atrial lead was introduced directly through cephalic

vein cut-down without peel away sheaths. The RVOT approach was initially done, then the lead stylet is curved in a swan Gans pattern and the lead manipulated toward the septal side of the RVOT while ventricular pacing is continuously applied. Postero Anterior (PA), right anterior oblique (RAO), and left anterior oblique (LAO) fluoroscopy views are used until we obtained a narrow QRS. In two cases a trial of a membranous interventricular septal approach before crossing the tricuspid valve was tried and a narrow QRS with RV pacing obtained. Post implantation patient rested in bed for 24 hours and then mobilized. Chest X-ray and pacemaker check done and the patient discharged home to be seen in a follow up the clinic after 12 days. Local garamycine of 160mgs injected at the pocket site and prophylactic iv antibiotic composed of a combination of amoxicillin plus cloxacillin and garamycine were given 2 hours before the procedure and continued for five days after the procedure.

RESULTS

The total number of the patient considered for HBP was 45 P. There were 25 males and 20 females. The mean age was 35-78 Y. The indication for pacing in those patients was as follows: a high grades AV block associated with heart failure in 12 p and without heart failure in 8 P, b, previous RVA pacing caused RV perforation in 4 p. Figure 1, shows the basic ECG of 2:1 AVB. b, shows the RVA pacing and c shows HBP. In 21 patients the indication of HBP was the failure of CS cannulation in CRT indication or improper, unstable or failed positioning of epicardial LV lead due to CS venous anomalies, 10 of them through bifocal RV pacing and in the other 11 p with intentional (provisional) HBP with backup RVA lead. Figure 2 showing the 12 lead ECGs in CRT patients before and after HBP. Figure 3 shows the cardiac size in a patient with HF; notice the reduction of cardiac size a day after HBP and a few months later.

From a total trial of 45 patients, we achieved a narrow QRS suggesting HBP success in 30 patients (67%) who are included in this study. The average total procedure time in HBP was 90^{+}_{-} 15 minutes. Fluoroscopy time was in the range of 5±1.5 minutes.

The indication of successful HBP is the narrowing of the paced QRS during continuous RV pacing from the basic either wide QRS of 140-160msc to 80-100msc or achieving almost the same width QRS in already pre pacing narrow QRS. HBP commonly needs higher pacemaker output to achieve His capture and narrow QRS but the occasionally lower output is needed to capture the His bundle rather than the adjacent myocardial tissue. The pacing threshold in HBP only rose slightly from 1v to 1.25 v over the follow-up period of 24 months in 10 patients. In 3 patients lower output needed to achieve HBP with a non-selective pacing pattern, Figure 4.

Amongst the 15 patients with high grades AVB who received HBP, no patients developed pacing-induced cardiomyopathy over the 24 months of follow up. The LVEF was sustained to normal values during the follow-up period in that group of patients.

No post device infection was noticed in the 30 patients included. The average follows up period was $24^{\pm}2$ months. The pacing threshold in HBP only rose slightly from 1v to 1.25 v over the follow-up period of 24 months in 10 patients. In 3 patients lower output needed to achieve HBP with a non-selective pacing pattern.

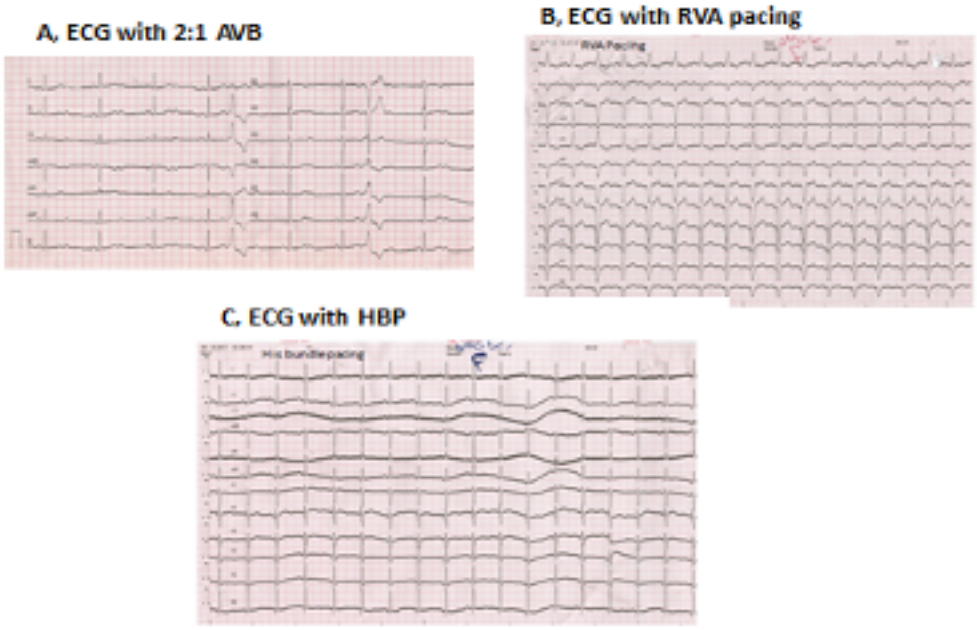


Figure 1. The 12 leads ECG of the same patient. He was upgraded from RVA pacing into HBP after RVA myocardial perforation. Showing the QRS width in A of 80msc and B of 130msc and C of 80msc. The QRS with HBP is almost normal.

Figure 2. The bottom ECG before HBP is showing LBBB with a QRS width of 145msc, the top ECG shows the HBP QRS width of 80msc.

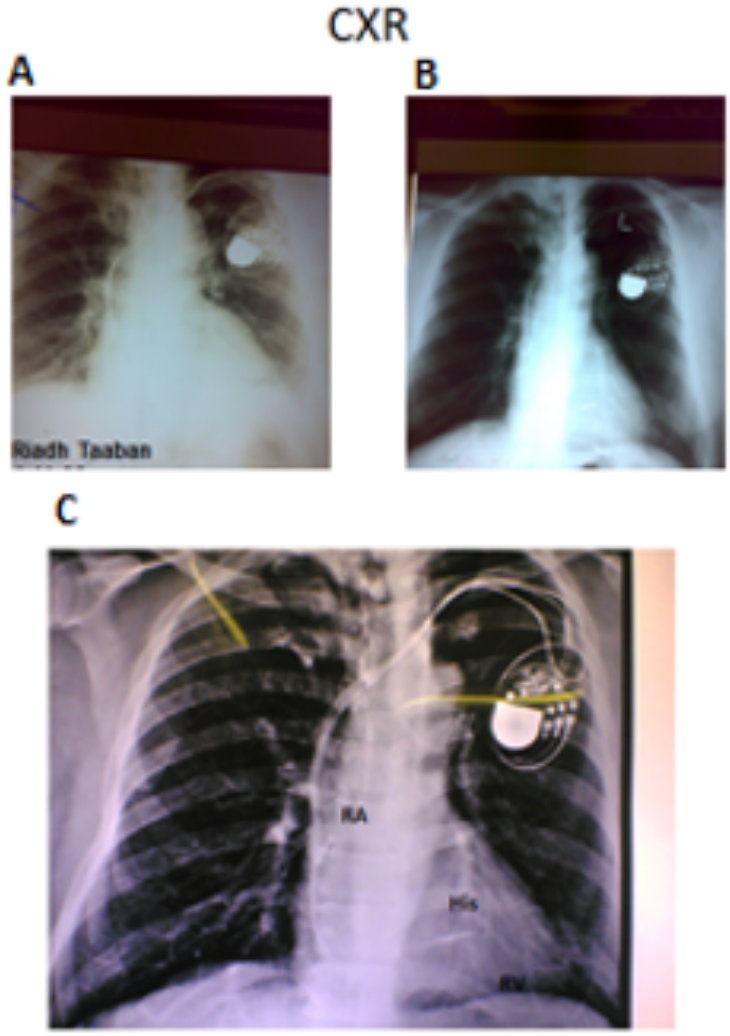
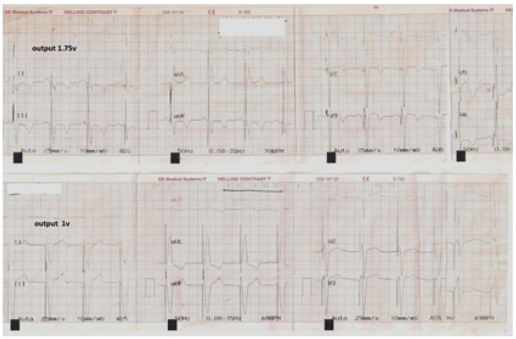
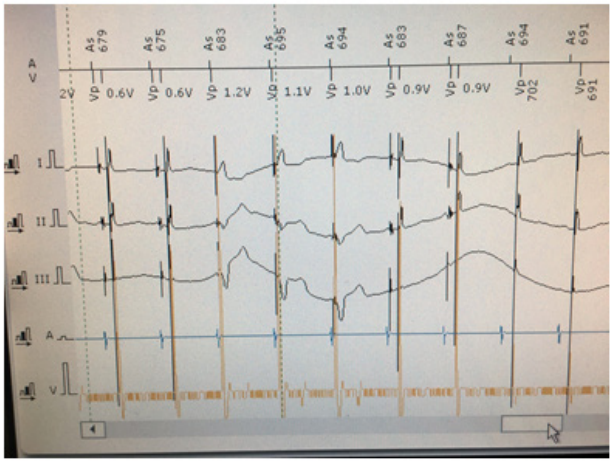


Figure 3. A. CXR same day of HBP /CRT pacemaker implantation. B. five months after HBP. C. showing the HBP lead position. The cardiac size was significantly reduced with HBP.



A

B



C

Figure 4. A. ECG showing narrow paced QRS with 1.7 v pacing output and wider paced QRS with 1 v output. B. ECG showing the dynamic changing of HB capture indicated by narrow and wide paced QRSs. C. Changing paced QRS width with changing output during ventricular threshold testing.

DISCUSSION

The use of HBP has largely increased lately as an indication for both AVB and in CRT after the failure of CS/LV stabilization[5, 9, 11, 15-20]. In all previous trials for HBP a specific His leads Select Secure 3830 from Medtronic (Medtronic, Minneapolis, MN, USA) was used with special nondeflectable or deflectable His delivery sheath [9, 10, 13-22]. In our series we used conventional active fixation leads from different companies with standard peel away sheaths for the introduction of the lead. The HB leads are not available to us where we practice at Sulaimanya of the Kurdistan region in Iraq. The low success rate of 66% we achieved in comparison to other series of 80-90% success rate used the special HB leads and delivery system is due to rather a blind technique depended on an anatomical assessment of His position and achieving a narrow paced QRS within the continuous ventricular pacing procedure we adopted. The blind technique means we used no His bundle electrophysiological mapping. The pattern of HBP we achieved is mostly a non-selective type in the majority of cases which is not much hemodynamically different from selective HBP [21, 22]. The pacing threshold rise over the follow-up period of 24 months in comparison to other series using the special HB leads is technically quite acceptable.[16, 23]. Electrocardiographic and EGMs transitions during threshold testing can help accurately differentiate between selective and non-selective HBP[21, 24]. The difference between selective and non-selective HBP seems to be small as far as outcomes of HF history,

clinical improvement, and mortality [17- 21]. We feel that trying our blind method of HBP is quite reasonable to use in both conventional pacing indication for AVB or in failed cases of CRT CS/LV lead stabilization. Achieving HBP will reduce the incidence of RVP-ICM in patients with conventional pacing for high grades AV block and improve the LV function in patients with heart failure and indication for CRT.

In conclusion, HBP is safe, feasible, and can minimize the RV-PICM in patients needing conventional pacing and in CRT indication. Using the standard pacing lead and our blind technique is worth trying in those patients because it is safe, less expensive, less complicated, and feasible. Once technical insertion and leads are optimized, will be the procedure of choice for most patients with high grades AVB and patients with LBBB indicated for CRT. Increasing the success rate of HBP with new HB leads and delivery system is more superior if can be available to the implanting physician.

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