Indian Heart Journal 73 (2021) 117–120

Contents lists available at ScienceDirect

Indian Heart Journal

journal homepage: www.elsevier.com/locate/ihj

Research Brief

Feasibility, safety and outcomes of left bundle branch pacing in octogenarians

Shunmuga Sundaram Ponnusamy*, Dasarath Bopanna, Thabish Syed, Giridhar Muthu, Surya Kumar

Department of Cardiology, Velammal Medical College Hospital and Research Institute, Madurai, Tamilnadu, India

ARTICLE INFO

Article history:
Received 21 July 2020
Received in revised form
27 December 2020
Accepted 31 December 2020
Available online 6 January 2021

Keywords:
Physiological pacing
Octogenarians
Heart failure

ABSTRACT

Objectives: Left bundle branch pacing (LBBP) provides physiological pacing at low and stable threshold. The safety and efficacy of LBBP in elderly population is unknown. Our study was designed to assess the safety, efficacy and electrophysiological parameters of LBBP in octogenarian (≥80 years) population.
Results: LBBP was successful in 10 out of 11 patients. Mean age 82.1 ± 2.5 yrs. Follow up duration 7.7 months(range4–10). Indication for pacing included atrioventricular (AV) block 5 patients, Left bundle branch block (LBBB) with low ejection fraction (EF) 4 patients, sinus node dysfunction in 1. QRS duration reduced from 145.9 ± 27.7ms to 107.1 ± 9.5ms (*p* value0.00001) LV ejection fraction increased from 47.6% to 58.4% after LBBP (*p* value0.017). Pacing threshold was 0.58 ± 0.22 V and sensed R wave 17.35 ± 6.5 mV and it remained stable during follow up. LBBB with low EF patients also showed similar reduction in QRS duration along with improvement in LVEF.
Conclusion: LBBP is a safe and effective strategy (91% acute success) of physiological pacing in elderly patients. LBBP also provided effective resynchronization therapy in our small group of elderly patients. The pacing parameters remained stable over a period of 10 months follow up.

1. Introduction

Physiological pacing offers the advantage of capturing His-purikinje system directly thereby achieving synchronized ventricular contraction.[1] Although His bundle pacing (HBP) offers the most physiological form of pacing, it has some inherent limitations. Huang et al[2] reported direct capture of left bundle (LB) by deep septal pacing as an alternative to overcome the limitations of HBP. Though the safety of left bundle branch pacing (LBBP) has been established by several studies, the data for elderly population is lacking. This paper describes the feasibility, safety and electrophysiological properties of LBBP in octogenarians.

2. Methods

This is a retrospective, observational study conducted in our institute from march 2019 to march 2020 after getting institutional ethical committee approval. Patients provided written informed consent regarding LBBP as a non-standard approach. All patients aged between 80 and 89 years who were planned for permanent pacemaker implantation and those requiring cardiac resynchronization therapy (CRT) were included in the study. Patients who refused for the therapy were excluded.

The procedure was done as described by Huang et al[3] using C315 sheath and 3830 SelectSecure^{tm} lead (Medtronic, Minneapolis, MN). In brief, the pacing lead was placed deep inside the septum at a site 1–1.5 cm below the His bundle (Fig. 1A). LB capture was confirmed by presence of right bundle branch delay pattern (qR in lead V1) along with any one of the following criteria[4] (a) presence of LB potential (b) non-selective to selective LB capture during unipolar threshold measurement (Fig. 1B) (c) short and constant peak left ventricular activation time (pLVAT) < 80ms. (d) programmed stimulation from the pacing lead to show change in QRS morphology, duration and axis. Patients baseline characteristics and indications for pacing were documented. LVEF was measured by modified simpson's method.

* Corresponding author. Department of Cardiology, Velammal Village, Airport ring road, Velammal Medical college hospital and research institute, Madurai, 625009, India.
E-mail address: shunmuga.pgi@gmail.com (S.S. Ponnusamy).

https://doi.org/10.1016/j.ihj.2020.12.017

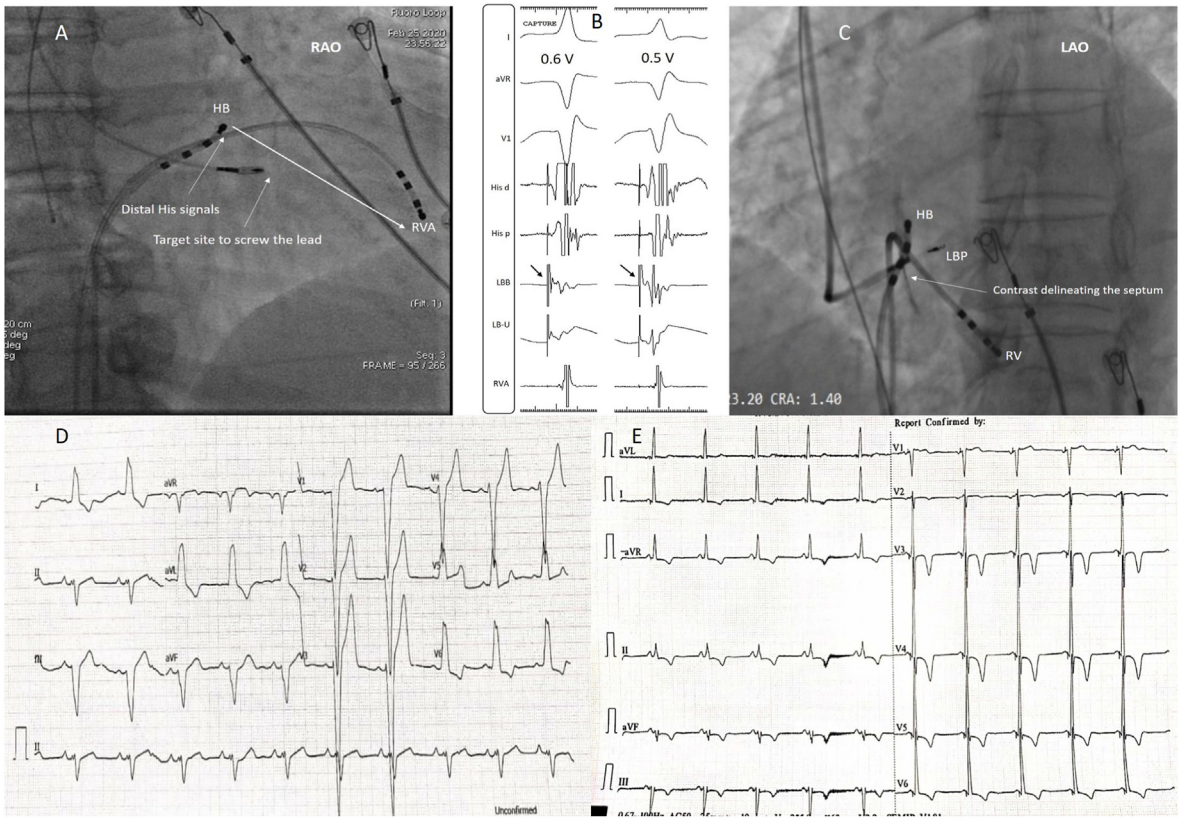

Fig. 1. LBBP for LBBB with low LVEF. A- RAO view showing the target site for the lead placement – 1.5 cm below distal His bundle (HB) along an imaginary line to RV apex (RVA). B – Non selective to selective LB capture as output reduced from 0.6 V to 0.5 V. Note the distinct LB lead electrogram after the pacing spike while selective capture along with change in QRS morphology from Qr to rSR in V1. C – Sheath angiography in LAO view showing the depth of the lead (LBP) inside the septum. D – Baseline ECG showing complete LBBB with QRS duration of 160ms. E– ECG after LBBP showing narrow QRS with T wave memory.

3. Results

11 patients satisfied the inclusion criteria. Successful LBBP could be performed in 10 out of 11 patients (91% acute success rate). In one patient with AV block, lead could not be penetrated deep and conventional RV lead was placed. Baseline and procedural characteristics are shown in Table 1. Mean age of the study population was 82.1 ± 2.5 years. The indication for pacemaker implantation was AV block in 5 patients, LBBB with low EF in 4 patients and sinus node dysfunction in one patient. The baseline QRS duration was 145.9 ± 27.7ms. Pre-procedural echocardiography showed mean EF of 47.6 ± 11.2% and septal thickness of 11.1 ± 0.7 mm.

The fluoroscopic time for LB lead placement was 17.9 ± 8.2 min. Non-selective to selective LB capture could be demonstrated in all patients (Fig. 1B). LB potential was noted in one patient. QRS duration was reduced to 107.1 ± 9.5ms (measured from the onset to the end;*p* value 0.00001). The pLVAT as measured in lead V5 (from pacing spike to peak of R wave) was 72.2 ± 5.3ms. The unipolar pacing threshold was 0.58 ± 0.22 V at 0.5ms pulse-width. The mean R wave amplitude was 17.35 ± 6.6 mV. The unipolar pacing impedance was 773.6 ± 112.9 Ω. All 4 patients with LBBB and low EF had complete correction of LBBB at low and stable threshold (Fig. 1C and D). No acute procedural complications noted.

3.1. Follow-up

The mean follow-up duration was 7.7 ± 1.9 months (range 4–10 months). The pacing threshold remained stable at 0.525 ± 0.07 V at 0.5ms pulse width and sensed R wave amplitude 15.6 ± 7.3 mV during follow up (Table 1B). The unipolar pacing impedance decreased to 663.1 ± 57.9 Ω (*p* value 0.002). Echocardiography showed significant improvement in LV ejection fraction from 47.6 ± 11.2% to 58.4 ± 3.7% (*p* value 0.017). The length of the lead inside the septum was 10.3 ± 0.82 mm. There was no acute or late lead dislodgement. There were no episodes of thrombo-embolism, pocket infection or mortality.

The findings are comparable to the general data on LBBP in Indian patients by our group where we showed 94% acute success rate with threshold of 0.59 ± 0.22 V and R wave of 14 ± 7 mV which remained stable over 12 months follow-up.[7] QRS duration was reduced from 144 ± 34ms to 110 ± 12ms along with improvement in LVEF from 44% to 53%.

3.2. Cardiac re-synchronization therapy

Four patients had undergone LBBP done for LBBB with low LVEF and normal epicardial coronaries. Three patients were symptomatic for the last four years and one had heart failure symptoms for two years. The age of onset of LBBB in these four patients were not known as serial ECGs were not available. The QRS duration was reduced from 169.7 ± 13.3ms to 111.5 ± 13.4ms and LVEF improved form 37.5 ± 8.8% to 57.7 ± 3.8% along with improvement in the NYHA functional class.

4. Discussion

Though multiple studies are available on feasibility and efficacy of LBBP,[5,6] there is no published data on safety of LBBP in elderly

Table 1
A- Baseline and procedural characteristics of the study population. B- Follow up data.

A	
Baseline and procedural Characteristics	
Total number of patients	11
Successful LB pacing	10 (91%)
Male	6
Female	4
Follow up (months)	7.7 (range 4–10 months)
Age in years	82.1 ± 2.5 years
Coronary artery disease	5 patients (50%)
Left ventricular function	
Ejection fraction <50%	7 patients
Ejection fraction >50%	3 patients
Pacing indications	
AV block	5 patients
LBBB with Low EF	4 patients
Sinus node dysfunction	1 patient
Procedural parameters	
LBBP fluoroscopy time (minutes)	17.9 ± 8.2 min
pLVAT (ms)	72.2 ± 5.3 ms

B	At implantation	Follow up (4–10 months)	*p* Value
Pacing Parameters			
Threshold (Unipolar)	0.58 ± 0.22 V	0.525 ± 0.07 V	0.23
R wave (mV)	17.35 ± 6.5 mV	15.65 ± 7.3 mV	0.26
Pacing Impedance (ohms)	773.6 ± 112.9 Ω	663.1 ± 57.9 Ω	0.002
ECG – QRS duration (Pre and Post)	145.9 ± 27.7ms (Pre)	107.1 ± 9.5 ms (post)	0.00001
LV ejection Fraction	47.6 ± 11.2%	58.4 ± 3.7%	0.017
Safety Parameters			
Lead dislodgement		Nil	
Late rise in Threshold by > 1 V		Nil	
Thrombo-embolic episodes		Nil	
Mortality		Nil	

patients. In this paper we have shown that LBBP could be successfully done in 10 out of 11 patients without any procedural complication. LBBP could reduce the QRS duration from 145.9 ± 27.7ms to 107.1 ± 9.5ms (*p* value 0.00001). LV ejection fraction improved from 47.6 ± 11.2% to 58.4 ± 3.7% (*p* value 0.017) during follow up. The lead parameters remained stable during follow up (Table 1B). All these findings are comparable to the published studies by other authors on LBBP[5,7,8]

Generally, CRT trials have excluded very old patients (>80 years old) and little data exist on outcomes of CRT in elderly.[9] Rigot et al,[10] in a retrospective study showed that the response to CRT was not compromised in patients aged >75 years with 14% mortality at the end of one year. Achilli et al[11] showed 2.4% LV lead dislodgement in patients aged >80 years undergoing CRT. Though similar clinical efficacy was noted as compared to those under 80 years, 17.3% mortality occurred during follow up of 12 months. LBBP could be safely done as an alternative for cardiac re-synchronization therapy in our small cohort aged ≥80 years. We could also show significant reduction in QRS duration along with improvement in LVEF in these patients. With the stable lead parameters and less procedural complication rate, LBBP has the potential to be an excellent alternative to CRT in elderly patients.

5. Conclusion

Left bundle branch pacing is a safe strategy of physiological pacing in octogenarians and we could show significant reduction in QRS duration and improvement in LV ejection fraction. Since it is a single center, retrospective observational study involving small numbers data cannot be extrapolated to general population. Further prospective, multicenter, randomized controlled trials will be required to assess the long safety of LBBP.

Key messages

1. Left bundle branch pacing is a novel strategy of physiological pacing with promising results
2. Safety and efficacy of LBBP in octogenarians are not well studied
3. This is the first study showing the feasibility and safety of LBBP with excellent mid-term outcomes
4. Cardiac resynchronization therapy by LBBP is feasible with promising results

Financial source

No funding or financial sources received for this study.

Declaration of competing interest

We have no conflicts of interest to disclose.

References

1. Vijayaraman P, Chung MK, Dandamudi G, et al. His bundle pacing. *J Am Coll Cardiol*. 2018;72:927–947.
2. Huang W, Su L, Wu S, et al. A novel pacing strategy with low and stable output: pacing the left bundle branch immediately beyond the conduction block. *Can J Cardiol*. 2017;33, 1736. e1–3.
3. Huang W, Chen X, Su L, et al. A beginner's guide to permanent left bundle branch pacing. *Heart Rhythm*. 2019;16:1791–1796.

4. Ponnusamy SS, Arora V, Namboodiri N, et al. Left bundle branch pacing: a comprehensive review. *J Cardiovasc Electrophysiol*. 2020 (article in press).
5. Vijayaraman P, Subzposh FA, Naperkowski A, et al. Prospective evaluation of feasibility, electrophysiologic and echocardiographic characteristics of left bundle branch area pacing. *Heart Rhythm*. 2019;16:1774–1782.
6. Zhang J, Wang Z, Cheng L, et al. Immediate clinical outcomes of left bundle branch area pacing vs conventional right ventricular pacing. *Clin Cardiol*. 2019;42:768–773.
7. Ponnusamy SS, Muthu G, Kumar M, et al. Mid-term feasibility, safety and outcomes of left bundle branch pacing – single center experience. *J Intervent Card Electrophysiol*. 2020. https://doi.org/10.1007/s10840-020-00807-w.
8. Li Y, Chen k, Dai Y, et al. Left bundle branch pacing for symptomatic bradycardia: implant success rate, safety, and pacing characteristics. *Heart Rhythm*. 2019;16:1758–1765.
9. Senni M, Tribouilloy CM, Rodeheffer RJ, et al. Congestive heart failure in the community. A study of all incident cases in Olmsted County, Minnesota, in 1991. *Circulation*. 1998;98:2282–2289.
10. Champ-Rigot L, Cornille AL, Ollitrault P, et al. Predictors of clinical outcomes after cardiac resynchronization therapy in patients ≥75 years of age: a retrospective cohort study. *BMC Geriatr*. 2019;19:325.
11. Achilli A, Turreni F, Gasparini M, et al. Efficacy of cardiac resynchronization therapy in very old patients: the Insync/Insync ICD Italian Registry. *Europace*. 2007;9:732–738.