ORIGINAL ARTICLE

Feasibility and safety of left bundle branch area pacing in very elderly patients (≥80 years)

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ABSTRACT

Background: Left bundle branch area pacing (LBBAP) has emerged as a promising physiologic pacing strategy. Though many clinical studies have established the feasibility and safety of LBBAP, the data for very elderly patients are lacking.

Aims: This study aimed to assess the feasibility and safety of LBBAP in very elderly patients (≥80 years).

Methods: Two hundred and forty consecutive patients who received LBBAP implantation were retrospectively enrolled in the present study. Inclusion criteria were patients with atrioventricular block, atrial fibrillation with a slow ventricular response, and heart failure with bundle branch block. The patients were divided into two groups: those aged ≥80 years and those aged <80 years. LBBAP implantation was successfully performed in 48 of 53 (90.6%) very elderly patients and 162 of 187 (86.5%) counterparts. In the very elderly group, the mean (standard deviation [SD]) age was 84 (3) years, mean (SD) paced QRS duration was 112.4 (9.0), and the mean (SD) stimulus to R wave peak time was 82.0 (14.2) ms. Mean (SD) pacing thresholds and mean (SD) R wave sensing were 0.61(0.21) V and 12.1 (4.7) mV at implant. Pacing parameters in very elderly patients were similar to those in their counterparts. During a median follow-up of 6 months, pacing parameters remained stable. Five patients in the very elderly group developed complications (1 with septal perforation during the procedure, 1 with pocket hematoma, 1 with pacing threshold increase, and 2 with micro lead dislodgement during follow-up).

Conclusion: LBBAP is safe and effective in patients ≥80 years old. LBBAP can be considered as an alternative method for delivering physiological pacing in this special population.

Key words: feasibility, left bundle branch area pacing, physiological pacing, very elderly patients, safety

INTRODUCTION

The proportion of very elderly patients requiring permanent pacemaker implantation (PPM) has increased due to improved therapeutic options for heart disease and augmented life expectancy [1]. It is also related to the pathomorphological changes that occur in the cardiac conduction system with advancing age and the coexistence of hypertension or ischemic heart disease [2]. In a recent study, severe complication rates and life prognosis after traditional PPM were reported to be similar between patients aged ≥ and <85 years [3]. However, controversy over PPM in very elderly patients still occurs since they are burdened with many cardiovascular risk factors [4].

Left bundle branch area pacing (LBBAP) has emerged as an alternative method for delivering physiological pacing to achieve electrical synchrony of the left ventricle [5]. According to the experience in our center, since the target is much broader and the left bundle branch has fibers fanning on the subendocardial aspect of the left side of the interventricular septum, LBBAP is easier to perform than His bundle pacing (HBP). Though many

WHAT'S NEW?

The study demonstrates that left bundle branch area pacing (LBBAP) is safe and effective in patients ≥80 years old. Pacing thresholds and R wave sensing were similar to those in the control group and remained stable during follow-up. The complication rate was not higher than the in counterparts. LBBAP can be considered as an alternative method for delivering physiological pacing in this special population.

clinical studies have established the feasibility and safety of LBBAP [5–8], the data for very elderly patients are lacking. In this study, we explored the feasibility and safety of LBBAP in patients ≥80 years old.

METHODS

Study population

Consecutive patients with a PPM indication who underwent LBBAP were retrospectively evaluated from April 2018 to December 2020. Inclusion criteria were patients with AVB, atrial fibrillation with a slow ventricular response, and heart failure with left bundle branch block (LBBB). Patients diagnosed with LBBB should meet the Strauss criteria: QRSd ≥130 ms in women, ≥140 in men, QS or rS in leads V1 and V2, and mid-QRS notching or slurring in 2 of leads V1, V2, V5, V6, I, and aVL. Then patients were divided into two groups: those aged ≥80 years and those aged <80 years as a control group (Supplementary material, *Figure S1*). The study protocol was approved by the Institutional Review Board of the 1st Affiliated Hospital of Nanjing Medical University, and all patients gave written informed consent.

LBBAP implantation procedure

The detailed implantation procedure was the same as those we have previously reported [9]. The custom ventricular pacing electrode (Minneapolis, MN 3830 electrode) was introduced transvenously into the right ventricle using a 7-Fr guiding catheter (Model C315-S10; Medtronic Inc., Dublin, Ireland). After positioning against the basal or middle ventricular septum, the ventricular lead was driven through the interventricular septum to catch the left bundle branch. Pre-implantation echocardiography was performed routinely to evaluate the thickness of the septum. During lead fixation, the paced QRS morphology and the impedance were carefully monitored. Sheath angiography is a useful way to avoid septum perforation. The penetration depth was assessed by injecting small amounts of contrast medium through the guiding catheter under fluoroscopy in left anterior oblique (LAO) 40-degree view (Supplementary material, *Figure S2*). An estimation of penetration depth was provided in combination with earlier knowledge of the lead tip dimension (10.8 mm from tip to ring) and the IVS wall thickness. Successful LBBAP was defined as unipolar paced QRS with RBBB-like morphology and with at least one of the following three conditions fulfilled: (1) LBB potentials; (2) selective LBB capture; (3) short and constant stimulus to R wave peak time in surface leads V5–6 (RWPT) at high- and low-output pacing or RWPT abruptly shortening more than 10 ms at high-output pacing.

Data collection

Baseline patient characteristics (especially the comorbidities, such as hypertension, coronary artery disease, and diabetes mellitus) and indications for PPM were documented. Baseline QRSd and the presence of BBB were also recorded. Paced QRSd (without the pacing artifact and the initial latency) and RWPT were recorded. According to the novel criterion described by Jastrzębski et al. [10], which suggested different optimal cut-off values of RWPT for LBB capture, the diagnosis was 83 ms in patients with narrow QRS and RBBB and 101 ms in patients with LBBB and non-specific intraventricular conduction disturbance; we differentiated between LBB pacing and LV septal pacing. Pacing threshold, R wave sensing, impedance, and pacing percentages were documented at implant, at 1-week follow-up, and at 1-, 6- and 12-month follow-up. Total fluoroscopy doses for LBBAP lead placement and procedure duration were also documented. Transthoracic echocardiography was performed at baseline and 6-month follow-up. Left ventricular ejection fraction (LVEF), left ventricular end-systolic diameter (LVESD), and left ventricular end-diastolic dimension (LVEDD) were measured. Complications during the procedure such as pneumothorax, pericardial effusion, and septum perforation were recorded. Device-related infection, pocket hematoma, postoperative septum perforation, macro lead dislodgment, or micro lead dislodgement at any time during follow-up were recorded. Micro lead dislodgment was defined as failing to capture the left-sided conduction system resulting in a QS pattern in V1.

Statistical analysis

Continuous variables were expressed as mean (standard deviation [SD]) and compared by independent t-test if the data were normally distributed. Nonnormally distributed variables were expressed as the median with interquartile range (IQR) and compared by Mann-Whitney U-tests. Categorical variables were expressed as observed number and percentage values. Pearson's χ^2 test and Fisher's exact test were used to compare categorical variables. A linear mixed-effect model was used to analyze the repeated measurement data. All *P*-values were two-tailed, and *P*-values of <0.05 were considered significant. Statistical

Table 1. Patient characteristics

	Age <80 years (n = 187)	Age ≥80 years (n = 53)	*P*-value
Age, years, mean (SD)	66 (10)	84 (3)	<0.001[a]
Male gender, n (%)	111 (59.4)	33 (62.3)	0.703
Hypertension, n (%)	96 (51.3)	41 (77.4)	0.001[a]
Diabetes mellitus, n (%)	56 (29.9)	24 (45.3)	0.037[a]
Coronary artery disease, n (%)	40 (21.4)	12 (22.6)	0.845
AF, n (%)	57 (30.5)	21 (39.6)	0.210
Renal failure, n (%)	13 (7.0)	2 (3.8)	0.532
Syncope, n (%)	29 (17.0)	9 (15.5)	0.795
NT-proBNP, pg/ml, median (IQR)	679.4 (199.1–2078.0)	804.2 (308.1–2033.0)	0.577
Baseline QRSd, ms, mean (SD)	130.1 (37.7)	121.5 (32.3)	0.106
LVEF, %, mean (SD)			
≥50%	62.8 (3.2)	63.1 (4.0)	0.601
<50%	34.3 (8.3)	41.9 (2.2)	<0.001[a]
LVEDD, mm, mean (SD)	53 (9)	48 (5)	<0.001[a]
IVS, mm, mean (SD)	10.1 (1.5)	10.5 (1.4)	0.089
Pacemaker indication			0.111
Atrioventricular block, n (%)	124 (66.3)	41 (77.4)	
AF with slow ventricular response, n (%)	26 (13.9)	8 (15.1)	
Heart failure with LBBB, n (%)	37 (19.8)	4 (7.5)	
LBBB, n (%)	44 (23.5)	8 (15.1)	0.188
RBBB, n (%)	22 (11.8)	14 (26.4)	0.008[a]

[a]P <0.05

Abbreviations: AF, atrial fibrillation; IVS, interventricular septum; LBBB, left bundle branch block; LVEDD, left ventricular end-diastolic dimension; LVEF, left ventricular ejection fraction; NT-proBNP, amino-terminal pro-brain natriuretic peptide; RBBB, right bundle branch block

analysis was performed using SPSS 24.0 (IBMCorp, Armonk, NY, US).

RESULTS

Baseline characteristics

Finally, 240 patients in total were enrolled in the present study and divided into 2 groups: those aged ≥80 years (n = 53) and those aged <80 years (n = 187). Basic clinical details are demonstrated in Table 1. In the very elderly group, the mean (SD) age was 84 (3) years. The most common pacemaker indications were AVB (41 patients) followed by atrial fibrillation with a slow ventricular response (8 patients) and heart failure with LBBB (4 patients). Twenty-two patients had BBB (8 left BBB and 14 right BBB). The prevalence of diabetes mellitus, hypertension and RBBB in the very elderly group was higher than in counterparts (diabetes mellitus: 45.3% vs. 29.9%; P = 0.037; hypertension: 77.4% vs. 51.3%, P = 0.001; RBBB, 26.4% vs. 11.8%; P = 0.008). Other baseline demographics did not differ significantly between the two groups.

Procedural and pacing parameters

LBBAP implantation was successfully performed in 48 of 53 (90.6%) very elderly patients and 162 of 187 (86.5%) counterparts. No difference was observed between the two groups (86.5% vs. 90.6%; P = 0.445). Left ventricular septum pacing resulting in a relatively narrower QRSd was performed in those patients who failed LBBAP. The mean (SD) paced QRSd and mean (SD) RWPT were 112.4 (9.0) ms and 82.0 (14.2) ms in the very elderly group. There were also no significant differences between the two groups. Fluoroscopy doses for LBBAP lead placement, procedure duration, and the depth of lead implantation were the same between the two groups (Table 2). Capture thresholds, R wave sensing, and lead impedance tested at implant showed no significant difference between the two groups (Table 3). According to the criterion described by Jastrzębski et al. [10], the success rate of LBBP, paced QRSd and RWPT were also summarized in Table 2. No significant difference was observed between the two groups.

For patients with BBB, the details of electrocardiographic characteristics were summarized in Table 4. In the very elderly group, LBBAP resulted in LBBB correction in 5 of 8 (62.5%) patients, and mean (SD) QRSd decreased from 144.6 (12.6) ms to 109.2 (7.9) ms (P <0.001). In the aged <80 years group, LBBAP resulted in LBBB correction in 35 of 44 (79.5%) patients, and mean (SD) QRSd decreased from 170.0 (16.1) ms to 116.3 (9.1) ms (P <0.001). No difference was observed in the LBBB correction rate (P = 0.366) between the two groups.

Follow-up

For the very elderly patients, all patients completed pre-discharge follow-up, and 27 patients completed 6-month follow-up. The median (interquartile range [IQR]), follow-up duration was 6 (4–12) months in the very elderly group and 6 (1–12) months in the counterparts. Capture thresholds, R wave sensing, impedance, and pacing percentage are summarized in Table 4 and Figure 3. Supplementary material, *Table S1* contains the test results of fixed effects. There

Table 2. Pacing parameters

	Age <80 years (n = 187)	Age ≥80 years (n = 53)	*P*-value
Successful LBBAP, n (%)	162 (86.5)	48 (90.6)	0.445
Paced QRSd, ms, mean (SD)	114.3 (10.0)	112.4 (9.0)	0.240
RWPT, ms, mean (SD)	81.3 (12.0)	82.0 (14.2)	0.750
Depth of lead, mm, mean (SD)	11.3 (1.9)	12.1 (2.0)	0.123
Implantation duration, min, mean (SD)	118 (41)	93 (49)	0.099
X ray exposure dose, mGy, median (IQR)	18 (5–33)	27 (5–62)	0.601
Successful LBBP, n (%)	108 (57.8)	29 (54.7)	0.693
Narrow QRS/RBBB	75 (54.3)	24 (53.3)	0.869
Paced QRSd, ms, mean (SD)	111.8 (10.8)	110.9 (8.9)	0.709
RWPT, ms, mean (SD)	72.6 (7.0)	73.4 (6.4)	0.614
LBBB/NIVCD	33 (67.3)	5 (62.5)	1.000
Paced QRSd, ms, mean (SD)	116.9 (11.2)	109.2 (7.9)	0.148
RWPT, ms, mean (SD)	80.6 (9.3)	71.4 (13.8)	0.062

Abbreviations: NIVCD, non-specific intraventricular conduction disturbance; RWPT, R wave peak time; other — see Table 1

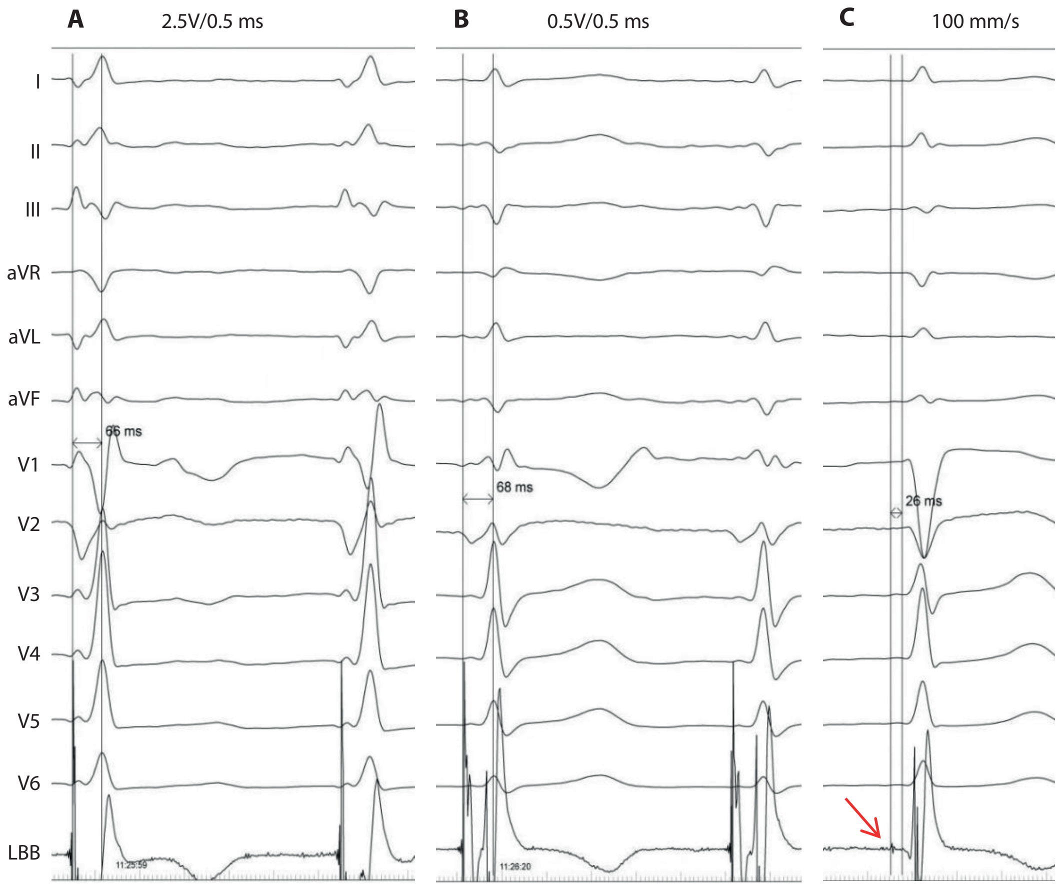

Figure 1. Nonselective to selective left bundle branch area pacing and left bundle branch potential

Abbreviation: LBBAP, left bundle branch area pacing

was no interaction between grouping factors and time factors (Threshold: F = 0.356; $P = 0.839$; Sensing: F = 0.970; $P = 0.424$; Impedance: F = 2.225; $P = 0.065$), which indicated the mean pacing parameters of the two groups were close and followed similar trends over time. There was no significant difference between groups (Threshold: F = 0.645; $P = 0.424$; Sensing: F = 1.480; $P = 0.225$; Impedance: F = 0.319; $P = 0.573$). Time factors had an effect and the mean pacing parameters were statistically different over the time points (Threshold: F = 11.837; $P < 0.001$; Sensing: F = 13.617; $P < 0.001$; Impedance: F = 286.229; $P < 0.001$). Multiple pairwise comparisons were made, and the *P*-value

Table 3. Pacing parameters at implant and follow-up in two groups

	N (%)	Threshold, V/0.4 ms, mean (SD)	Sensing, mV, mean (SD)	Impedance, Ω, mean (SD)	Pacing percentage, %, median (IQR)
Age ≥80 years					
At implant	48 (100.0)	0.61 (0.21)	12.1 (4.7)	803 (147)	—
1 week	48 (100.0)	0.51 (0.12)	14.6 (4.1)	518 (131)	99.8 (88.6–100.0)
1 month	31 (64.6)	0.55 (0.11)	15.9 (3.4)	455 (57)	100.0 (73.9–100.0)
6 months	27 (56.3)	0.60 (0.13)	15.6 (5.3)	444 (51)	99.9 (97.8–100.0)
12 months	14 (29.2)	0.64 (0.13)	14.2 (2.7)	430 (39)	99.9 (78.4–100.0)
Age <80 years					
At implant	162 (100.0)	0.59 (0.18)	12.4 (6.5)	780 (166)	—
1 week	144 (88.9)	0.51 (0.13)	14.4 (4.0)	497 (102)	99.9 (96.1–100.0)
1 month	103 (63.6)	0.57 (0.12)	17.2 (6.3)	468 (79)	99.9 (93.9–100.0)
6 months	87 (53.7)	0.66 (0.17)	16.0 (5.1)	476 (88)	99.7 (84.6–100.0)
12 months	58 (35.8)	0.68 (0.18)	16.5 (5.6)	460 (68)	99.8 (87.4–100.0)

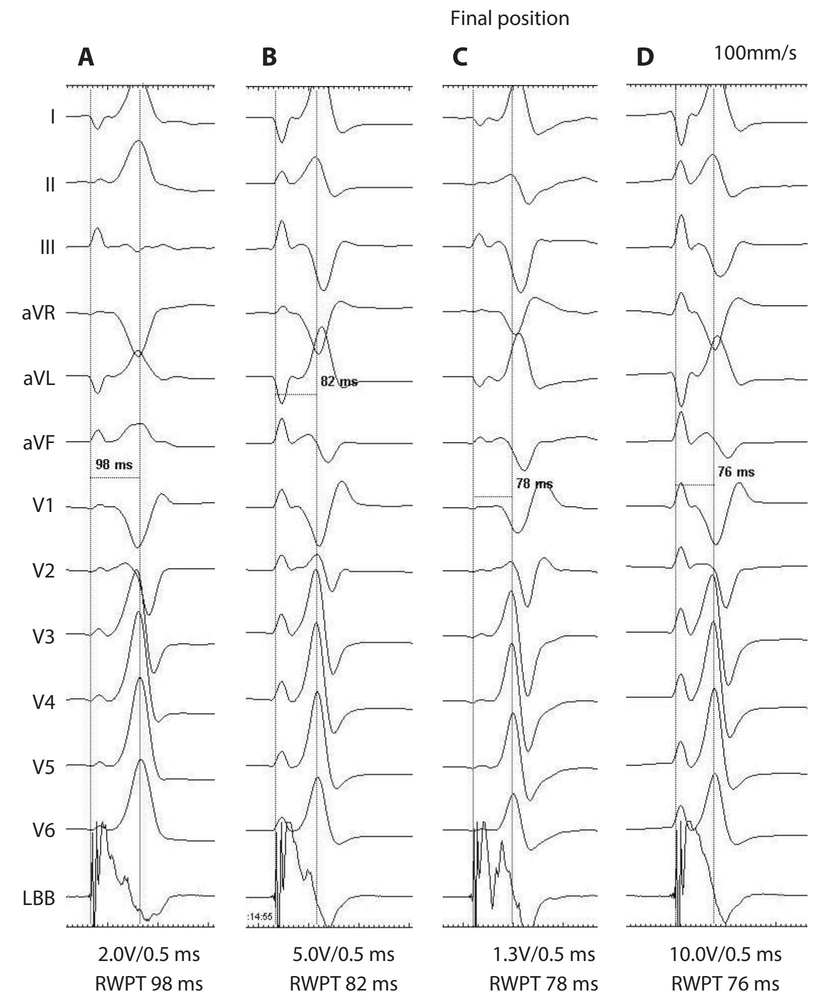

Figure 2. Dynamic changes of R wave peak time in surface leads V5–6 during left bundle branch area pacing procedure

were displayed in Supplementary material, *Tables S2–S4*. In the very elderly group, compared to baseline data, pacing thresholds and impedance decreased (mean [SD], 0.61 [0.21] V/0.4 ms vs. 0.51 [0.12] V/0.4 ms; P = 0.004; mean [SD], 803 [147] Ω vs. 518 [131] Ω; P <0.001), while R wave sensing increased (mean [SD], 12.1 [4.7] mV vs. 14.6 [4.1] mV; P = 0.005) in 1 week after implantation. Thereafter, pacing parameters remained stable over the follow-up period.

The echocardiographic parameters were presented in Supplementary material, *Table S5*. Eighteen patients in the very elderly group had echocardiography at 6-month follow-up. Compared to baseline, LVEF, LVEDD, and LVESD remained unchanged (mean [SD], LVEF: 62.2 [5.1] % vs. 62.3 [2.8] %; P = 0.941; mean [SD], LVEDD: 47.0 [4.5] mm vs. 46.1 [2.5] mm; P = 0.484; mean [SD], LVESD: 31.1 [4.2] mm vs. 31.0 [3.2] mm; P = 0.888) in 16 patients and 2 heart

Table 4. Electrocardiogram characteristics of patients with bundle branch block

	Age <80 years	Age ≥80 years	*P*-value
ALL (n)	66	22	
Successful LBBAP, n (%)	56 (84.8)	18 (81.8)	0.743
Baseline QRSd, ms, mean (SD)	162.1 (19.9)	145.9 (14.5)	0.002
Paced QRSd, ms, mean (SD)	117.4 (8.6)	110.6 (7.7)	0.004
RWPT, ms, mean (SD)	81.9 (11.4)	81.6 (15.4)	0.912
LBBB (n)	44	8	
Successful LBBAP, n (%)	35 (79.5)	5 (62.5)	0.366
Baseline QRSd, ms, mean (SD)	170.0 (16.1)	144.6 (12.6)	0.002
Paced QRSd, ms, mean (SD)	116.3 (9.1)	109.2 (7.9)	0.106
RWPT, ms, mean (SD)	83.0 (12.0)	71.4 (13.8)	0.054
RBBB (n)	22	14	
Successful LBBAP, n (%)	21 (95.5)	13 (92.9)	1.000
Baseline QRSd, ms, mean (SD)	148.5 (18.5)	146.5 (15.6)	0.740
Paced QRSd, ms, mean (SD)	119.3 (7.6)	111.2 (7.9)	0.005
RWPT, ms, mean (SD)	80.1 (10.3)	85.5 (14.6)	0.218

Abbreviations: see Table 2

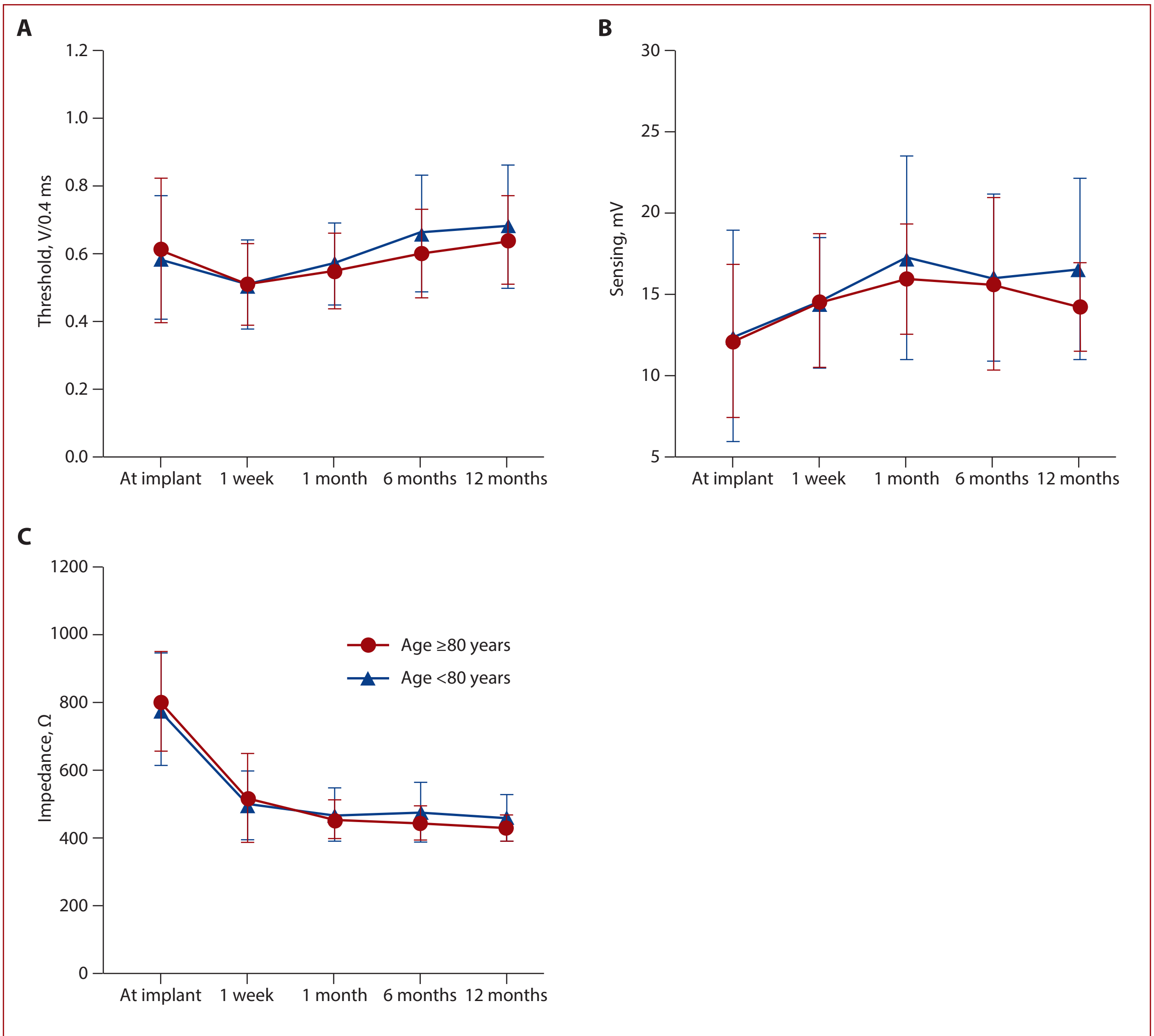

Figure 3. Pacing parameters at implant and during follow-up

Table 5. Complications

	Age <80 years (n = 162)	Age ≥80 years (n = 48)	*P*-value
Complications during procedure			1.000
Septal perforation, n (%)	4 (2.5)	1 (2.1)	
Complications during follow-up			0.483
Pocket hematoma, n (%)	2 (1.2)	1 (2.1)	
Macro lead dislodgement, n (%)	1 (0.6)	0	
Micro lead dislodgement, n (%)	5 (3.1)	2 (4.2)	
Increase of pacing threshold, n (%)	1 (0.6)	1 (2.1)	

failure patients with LBBB had improvements in LVEF of ≥5%. In the <80-year-old group, fifty-seven patients with normal cardiac function had echocardiography at 6-month follow-up and parameters remained unchanged (mean [SD], LVEF: 61.8 [7.3] % vs. 62.3 [5.0] %; $P = 0.452$; mean [SD], LVEDD: 49.6 [4.9] mm vs. 48.7 [4.0] mm; $P = 0.096$; mean [SD], LVESD: 33.1 [5.3] mm vs. 32.4 [4.0] mm; $P = 0.092$). Seventeen heart failure patients with LBBB had echocardiography at 6-month follow-up. Compared to baseline, LVEF improved from 35.9 (9.5) % to 45.3 (13.1) % (mean [SD]; $P = 0.006$), LVEDD decreased from 61.0 (8.4) mm to 55.9 (8.8) mm (mean [SD]; $P = 0.013$), and LVESD decreased from 50.1 (9.3) mm to 43.4 (11.0) mm (mean [SD]; $P = 0.010$). Five patients had improvements in LVEF of ≥5%, and eight patients had improvements in LVEF of ≥10%.

Complications

No significant difference was observed in complications between the two groups (Table 5). In the very elderly group, one septal perforation occurred during the procedure confirmed by contrast medium leaking into the LV cavity, and the lead was repositioned slightly away from the initial site. No pneumothorax or pericardial effusion was observed. During follow-up, one patient on oral anticoagulation developed pocket hematoma 2-weeks after discharge and recovered after discontinuing anticoagulant therapy. One patient had an increase in pacing threshold (>1V) to 2.75 V /0.4 ms at 24-month follow-up. Two patients had micro lead dislodgement (Supplementary material, *Figure S3*). Pacing parameters remained stable in both patients during follow-up, no lead revision was attempted. Other device-related complications such as device-related infection and postoperative septum perforation were not observed during follow-up.

DISCUSSION

Around 25% of clinical trials investigating the effects of new methods of treatment for cardiovascular diseases still overlook very elderly patients, and recommendations for management derived from younger patients frequently lack evidence-based support for these patients. Although clinical results tend to confirm the positive effect of physiological cardiac pacing on echocardiographic and hemodynamic parameters, as well as on exercise capacity and quality of life of these patients, a prevalence of right ventricular apex pacing in very elderly patients can still be observed [11, 12]. In this study, we demonstrated that LBBAP can be safely and effectively used in very elderly patients.

The ideal physiological approach to ventricular pacing should engage the normal conduction through the His-Purkinje conduction system. Based on a systematic review of the available published literature, HBP is recommended as a class IIa indication in patients requiring ventricular pacing who have an LVEF of 36% to 50% and as a class IIb indication in patients with AVB at the level of the AV node [13]. LBBAP can effectively overcome some limitations of HBP, such as high pacing thresholds and low sensing. In the 2021 ESC guidelines [14], LBBAP is mentioned as a very promising technique. However, recommendations for using LBBAP cannot be formulated for lack of solid evidence. Special pathomorphological changes in very elderly patients are usually related to the changes that occur in the cardiac conduction system with advancing age and the coexistence of hypertension or ischemic heart diseases [4]. In the present study, the very elderly patients showed a higher prevalence of hypertension, diabetes mellitus, and RBBB. These baseline characteristic differences are consistent with a more advanced pathophysiological state.

In the first case of LBBAP reported by Huang et al. [15], the patient was a 72-year-old female who had heart failure with dilated cardiomyopathy. In the following studies, the feasibility and safety of LBBAP were demonstrated in patients with normal QRS complex and symptomatic bradycardia such as SND (age, 63.8 [11.4] years) or AVB (age, 55.1 [18.5] years) [16]. In the study of Vijayaraman et al. [5], the age was 75 (13.1) years. In a recent study, the researchers reported successful application of LBBAP in a 10-year-old child with LBBB and enlarged heart size [17]. In our study, the average age of the very elderly group was 84 (3) years. Paced QRSd, RWPT, pacing parameters, and procedure parameters were the same as those in the group of patients aged <80 years. Pacing parameters remained stable over follow-up.

In this vulnerable population, complications are worthy of attention. Physicians usually prejudge those elderly patients who may have higher complication rates due to their comorbidities. According to the published LBBAP studies, the overall incidence of lead dislodgments (1%) and septal perforations (1.7%) was low. In a single-center experience reported by Chen et al. [18], the procedure-related complications rate of LBBAP was only 1.63% (10/612) including 2 postoperative septum perforations, 2 postoperative lead dislodgements, 4 intraoperative septum injuries, and 2 intraoperative lead fractures. The incidence of micro lead dislodgement described by Ravi et al. [19] was relatively high, which was noted in 4 patients (7.0%). In a recent study, the novel continuous pace mapping technique described by Jastrzębski et al. [20] enabled real-time monitoring of lead behavior and depth, facilitated reaching the LBB capture area, and had the potential to limit the risk of septal perforation. In the current study, the complication rate in very elderly patients was not higher than in their counterparts. One patient in the very elderly group developed septum perforation during the procedure, and the lead was successfully revised. One patient's pacing threshold increased by more than 1V at 24-month follow-up, and in two patients micro lead dislodgement occurred, no lead revision was attempted.

Beyond the traditional use of LBBAP for symptomatic bradycardia, another potential application in the very elderly patients is HF with LBBB, which is a cardiac resynchronization therapy (CRT) indication according to the guidelines. The traditional cardiac venous CRT procedure is complicated and time-consuming. Additionally, about 10% of patients remain untreated owing to an unsuitable coronary sinus venous branch. In a recent report by Huang et al. [8], LBBAP was successfully performed in 61 of 63 patients with nonischemic cardiomyopathy (97%, mean age 68 [11] years, LVEF 33 [7.4]%), and QRSd narrowed significantly from 169 (16) ms to 118 (12) ms. In the present study, 2 of 4 heart failure patients with LBBB in the very elderly group achieved successful LBBAP and had improvements in LVEF of ≥5% at 6-month follow-up.

In the study of Jastrzębski et al. [10], the authors used dynamic electrocardiogram maneuvers with output-dependent and refractoriness-dependent QRS morphological changes as the "gold standard" and found optimal V6 RWPT cut-off for LBB capture diagnosis. This criterion was relatively strict, and the cut-off value might be changed due to differences in population and implantation techniques. They measured the stimulus to RWPT in V6, but we measured stimulus to the RWPT in V5 or V6, decided by which was longer. It might also affect the results. In the present study, the success rate of LBBP was low diagnosed by the novel criterion in both groups. We were focused on the effectiveness and safety of LBBAP in elderly patients and attached more importance to minimizing its duration. Such an approach might increase the risk of complications, like septum perforation, in pursuit of the perfect LBBP for this vulnerable population.

Limitations

First, the sample size of heart failure patients with LBBB was small. This was a preliminary, single-center, and retrospective study, and further trials should be conducted in such patients. Second, the safety of LBBAP, compared between our two groups, might be better if using the Kaplan-Meier method. Uni and multivariate analysis may reveal the impact of age on the risk of LBBAP. However, the multivariate analysis could not be estimated owing to few patients with complications. Third, in this <1-year follow-up study the LBBAP appears safe in the very elderly, but complications that can be significant persist. Long-term data are needed to determine which elderly population subsets may benefit.

CONCLUSION

LBBAP is safe and effective in patients ≥80 years old. Therefore, LBBAP can be considered an alternative method for delivering physiological pacing in this special population.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

Conflict of interest: None declared.

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