Research Square

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Left Bundle Branch Area Pacing Reduces Pacemaker-Induced Cardiomyopathy and Heart Failure Admissions Compared with Right Ventricular Apical Pacing in High-Degree AV Block

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Abstract

Background and Aims

Right ventricular apical pacing (RVAP) is widely used in patients with high-degree atrioventricular block (HDAVB) but may induce electrical dyssynchrony and pacemaker-induced cardiomyopathy (PICM), particularly in those with a high ventricular pacing (VP) burden.

Compare long-term electrical, echocardiographic, and clinical outcomes of left bundle branch area pacing (LBBAP) versus RVAP in patients with HDAVB and preserved or mildly reduced left ventricular ejection fraction (LVEF).

Methods

In this single-center retrospective study, consecutive patients with HDAVB and LVEF > 40% were included if VP burden exceeded 60% at follow-up. Patients underwent LBBAP or RVAP according to operator preference. The primary endpoint was PICM. Secondary endpoints included cardiovascular admissions (heart failure [HF] and/or new-onset atrial fibrillation [AF]) and changes in echocardiographic and electrical parameters.

Results

A total of 110 patients were included, with similarly high VP burden in both groups. LBBAP resulted in QRS narrowing, whereas RVAP significantly prolonged QRS duration ($p < 0.001$). At 12 months, LVEF remained stable with LBBAP but declined with RVAP ($p < 0.001$), with more favorable LV remodeling in the LBBAP group ($p = 0.039$). No patients undergoing LBBAP developed PICM, compared with 19.3% in the RVAP group ($p < 0.001$). HF admissions were significantly lower with LBBAP (3.8% vs 26.3%; $p = 0.01$). A non-significant trend toward fewer new-onset AF events was observed.

Conclusions

In patients with HDAVB and high VP burden, LBBAP preserves left ventricular function, prevents PICM, and reduces HF admissions compared with RVAP, supporting its use as a preferred pacing strategy.

Introduction

Conventional right ventricular apical pacing (RVAP) remains a common strategy for patients requiring permanent cardiac stimulation because of high-degree atrioventricular block (HDAVB). However, RVAP produces a non-physiological pattern of ventricular activation that may lead to mechanical dyssynchrony[1,2]. As a consequence, patients may develop pacemaker-induced cardiomyopathy (PICM) in up to 20% of patients[3], ultimately leading to adverse clinical outcomes such as heart failure (HF) and atrial fibrillation (AF), particularly when the ventricular pacing (VP) burden is high, as this is a major predictor of these events[4].

Left bundle branch area pacing (LBBAP) aims to preserve physiological activation by engaging the native His–Purkinje system and has emerged as a promising technique, potentially combining electrical resynchronization with procedural feasibility[5,6]. The vast majority of patients requiring chronic cardiac stimulation have normal or near-normal LVEF, but robust data on the ability of LBBAP to prevent PICM in HDAVB with a very high VP burden remain scarce[2,7,8]. Based on the prospective STAY trial[7], we performed a retrospective study with a larger sample size and longer follow-up to evaluate whether LBBAP better preserves ventricular function and reduces clinically relevant events compared with RVAP in patients with HDAVB and a high VP burden.

Methods

Study design

The STAY extended study (conduction System sTimulation to Avoid left ventricle dYsfunction) is a single-center retrospective study comparing long-term outcomes in a STAY-like population: patients with normal or near-normal LVEF undergoing pacemaker implantation because of HDAVB.

Study population

Consecutive patients requiring permanent pacemaker implantation because of HDAVB between January 2022 and December 2024, according to current guidelines, were evaluated for inclusion in the study. None of the patients had an indication for cardiac resynchronization therapy (CRT) or an implantable cardioverter-defibrillator (ICD) based on currently accepted criteria. All patients had to meet all inclusion criteria and none of the exclusion criteria.

Inclusion criteria:

1. Age ≥ 18 years.
2. Preserved or mildly reduced LVEF (Simpson > 40%) assessed by a recent transthoracic echocardiogram (< 12 months before implantation).
3. Indication for cardiac pacing based on the presence of HDAVB, with an anticipated high burden of ventricular pacing (> 60%).

Exclusion criteria:

1. Patients with an indication for a CRT or ICD device.
2. Patients with previously reduced LVEF (Simpson LVEF < 30%) that had subsequently recovered.
3. History of myocardial infarction/revascularization or cardiac valve replacement within 6 months before the index echocardiogram, and between implantation and the follow-up echocardiogram.
4. Pregnancy, active cancer treatment, or participation in another clinical trial with active treatment.

Data collection and follow-up

All patients underwent a complete evaluation before the procedure, according to our standard protocol, and at 3- and 12-month follow-up, including history, physical examination, and 12-lead ECG. Electronic medical records were also reviewed for all patients. Patients had had a transthoracic echocardiography before the procedure (within a maximum of 12 months) and at the end of follow-up. All echocardiographic studies were performed by an independent imaging core laboratory, blinded to the patients' treatment allocation. LVEF was calculated using Simpson's method. Pacemaker-induced cardiomyopathy was defined as a 10% decrease in LVEF resulting in an LVEF < 50%.

All patients underwent post-procedure device follow-up at 3 and 12 months in the outpatient device clinic, where lead parameters, including ventricular pacing threshold, were recorded. Patients who did not meet the criterion for a high ventricular pacing burden (> 60%) were excluded from the final analyses. Procedure-related complications were also recorded.

Pacing strategy and definitions

Patients received RVAP or LBBAP based on operator assignment. Implantation technique and device programming followed local standard practice. The procedure for implanting the LBBAP lead has been described elsewhere[5,9]. A Bard polygraph displaying a 12-lead ECG and one intracardiac signal channel was used in all cases to allow appropriate QRS measurements and visualization of conduction system signals in the pacing lead. The operator aimed to implant the LBBAP lead using an anatomical approach guided by unipolar stimulation from the lead, targeting a "W" pattern in V1. Either a lumenless active-fixation 4F lead or a stylet-driven active-fixation 6F lead was implanted using an appropriate dedicated left bundle sheath. The lead was advanced until a moderate drop in impedance was observed, together with conversion of the "W" pattern into a qR or rSR pattern in lead V1. LBBAP was confirmed during the implantation procedure according to the EHRA clinical consensus[10,11]. Follow-up ECGs were extracted from the electronic medical record and analyzed using Philips IntelliSpace ECG software. Based on ECG analysis, we divided patients in the LBBAP group into the following subgroups:

Left bundle branch capture (LBBP): Defined by capture of the LBB or one of its ramifications, generating transitions during threshold testing, and/or a QRS with RBBB morphology and variable duration depending on the degree of impairment present in the distal conduction system, fulfilling at least one of the duration criteria: rapid activation of the LBB leading to a short left ventricular activation time (LVAT), and/or a long time to right ventricular activation, represented by the V6-to-V1 interpeak time (IPT). When the R/S ratio in V6 was < 1, we analyzed aVL as previously described[9]. All patients fulfilling at least one of the EHRA criteria for definite LBB capture were included in this group.

Left ventricular septal pacing (LVSP)

Defined as capture of the left side of the interventricular septum, with a terminal R wave in V1, but without direct activation of the left conduction system (i.e., no fulfillment of any EHRA criterion for definite LBB capture).

Deep septal pacing (DSP)

The pacing lead is positioned deep within the septum but does not reach the left ventricular subendocardial area. There is no LBBAP capture; therefore, morphology in V1 is characterized by an LBBB pattern, although DSP can show a paced QRS narrower than that observed during right septal pacing or RVAP.

Objectives

The primary endpoint was the incidence of PICM at follow-up. Secondary endpoints were the admissions due to HF and/or new onset AF, CV admission, the ΔLVEF, the ΔLVEDD, and the Δpaced QRS duration from baseline to follow-up.

Statistical analysis

Continuous variables were summarized as mean ± SD (or median [IQR]) and categorical variables as number (%). Within-group changes were assessed with paired tests (paired t test or Wilcoxon signed-rank test, as appropriate). Between-group differences in changes were assessed with independent-samples tests and reported as mean differences with 95% confidence intervals. Event rates were compared using Fisher's exact test or the χ^2 test, as appropriate, and expressed as odds ratios with 95% confidence intervals. To evaluate differences in longitudinal changes between groups, analysis of covariance (ANCOVA) models were constructed for ΔLVEF, ΔLVEDD, and ΔQRS duration. Implantation strategy (LBBAP vs RVAP) was entered as the main effect, adjusting for age and the corresponding baseline value of the dependent variable. Adjusted mean differences with 95% confidence intervals were derived from estimated marginal means. Effect sizes are reported as partial eta squared (η^2p). Model assumptions were assessed through residual diagnostics and Levene's test for homogeneity of variances.

Clinical outcomes (PICM, HF admissions, CV admission and new onset AF) were first analyzed using unadjusted contingency analyses. Multivariable binomial logistic regression models were then fitted to determine the independent association between implantation type and clinical events, adjusting for age and baseline renal function (eGFR < 45 mL/min/1.73 m²). Results are expressed as odds ratios (OR) with 95% confidence intervals. Model discrimination was quantified using the area under the receiver-operating characteristic curve (AUC), and overall model fit was evaluated using McFadden's pseudo-R^2. Statistical analyses were performed using jamovi (version 2.7), built on R (version 4.5), with additional regression diagnostics conducted using the car and emmeans packages.

Raw statistics are provided as Supplementary Material (S1)

Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee (2025/12132). Written informed consent was obtained for all patients.

Results

Study population

A total of 110 consecutive patients with HDAVB and a LVEF > 40% were included during the study period (see Fig. 1). Table 1 shows the baseline clinical, electrical, and echocardiographic characteristics of both groups. Of note, patients in the RVAP group were slightly older and had a higher prevalence of CKD (eGFR < 45 mL/min/1.73 m²). The remaining variables, including cardiovascular risk factors, QRS duration and LVEF, did not differ between groups.

Table 1
Baseline population characteristics

Variable	LBBAP (n = 53)	RVAP (n = 57)	p-value
Age, years	77.5 ± 9.3	82.7 ± 7.3	0.005
Male sex, n (%)	32 (60.4%)	32 (56.1%)	0.653
Diabetes, n (%)	13 (24.5%)	15 (26.3%)	0.830
Hypertension, n (%)	44 (83.0%)	42 (73.7%)	0.236
Ischemic heart disease, n (%)	11 (20.8%)	10 (17.5%)	0.669
CKD, n (%)	2 (3.8%)	10 (17.5%)	0.030
Follow up, months	14 ± 6.46	15.3 ± 8.06	0.234
Baseline LVEF, %	58.8 ± 7.7	60.1 ± 7.0	0.462
Baseline LVEDD, mm	47.5 ± 5.2	47.6 ± 4.7	0.651
Baseline QRS duration, ms	134 ± 24.9	135 ± 24.4	0.902
Previous A.F.	22 (20%)	17 (15.5%)	0.201

AF, atrial fibrillation; CKD, chronic kidney disease; LVEDD, left ventricular end diastolic diameter.

Procedure outcomes

The intention-to-treat analysis for all outcomes was based on 53 patients undergoing a LBBAP procedure, independent on the exact placement of the lead (LBBP, LVSP or DSP) and 57 patients undergoing an RVAP procedure, which could be pure apex or septal apex. Crossovers were not considered in this retrospective study. Table 2 shows procedural parameters. Pacing acute threshold

was slightly but significantly higher in the LBBAP group (0.95 ± 0.3 V vs 0.75 ± 0.3 V at 0.4 ms; p < 0.001). Fluoroscopy time did not differ significantly between groups (430 ± 274 s in the LBBAP group vs 371 ± 314 s in the RVAP group; p = 0.35). Implantation success was lower in the LBBAP group (90.6%) than in the RVAP group (100%; p = 0.018). The 5 failed LBBAP procedures resulted in DSP. Periprocedural complications were rare and did not differ significantly between groups (0 vs 1 minor complication, respectively; p = 0.333).

Table 2
Procedural characteristics and pacing parameters

Variable	LBBAP (n = 53)	RVAP (n = 57)	p-value
Ventricular pacing burden, %	90.4 ± 19.7	91.7 ± 15.8	0.397
Pacing threshold, V	0.95 ± 0.34	0.75 ± 0.32	< 0.001
Fluoroscopy time, sec	430 ± 274	371 ± 314	0.355
Implant success, n (%)	48 (90.6%)	57 (100%)	0.018
Periprocedural complications, n (%)	0 (0%)	1 (1.8%)	0.333
Stimulation Mode DDD (%)	31 (58.5%)	34 (59.6%)	0.902

Basal and post-procedural ECG

Paced QRS duration at the end of the procedure shortened with LBBAP (baseline QRS: 134 ms; ΔQRSd: −4.9 ms ± 26 ms) but increased with RVAP (baseline QRS: 136 ms; ΔQRSd: +21 ms ± 32 ms), with a mean difference of − 25.9 ms (p < 0.001).

Development of PICM and cardiovascular admissions

The follow-up period was determined by the final control echocardiography (median, IQ1-IQ3: 12 months, 10–16 months for RVAP; 14 months, 11–17 months for LBBAP). A significant proportion of patients developed PICM with RVAP (11 patients, 19.3%), whereas none did so with LBBAP (p < 0.001; see Table 3). A clear reduction in HF episodes requiring admission was observed with LBBAP, with only 2 patients (3.8%) compared with 15 patients (26.3%) in the RVAP group. In the multivariable logistic regression model adjusted for age and CKD, RVAP remained independently associated with CV admission (OR 4.77; 95% CI 1.57–14.46; p = 0.006), mainly due to an increase in HF admission (OR 7.81; 95% CI 1.62–37.64; p = 0.01). Model discrimination was acceptable (AUC 0.746). Regarding new onset AF, there was a trend toward fewer episodes with LBBAP than with RVAP, with 3 patients (4.4%) versus 7 patients (9.9%), respectively [OR 2.7; 95% CI 0.56–12.2]; p = 0.197). Figure 2 shows PICM and cardiovascular admissions for both groups.

Table 3
Clinical outcomes

Clinical outcome	LBBAP (n = 53)	RVAP (n = 57)	OR (95% CI)	p-value
PICM	0 (0%)	11 (19.3%)	—	0.0006
CV admission	5 (9.4%)	22 (38.6%)	4.7651 (1.57–14.46)	0.006*
HF admission	2 (3.8%)	15 (26.3%)	7.81 (1.62–37.64)	0.010*
New onset AF°	3 (4.2%)	7 (9,9%)	2.701 (0.56–12.22)	0. 197*
AF, atrial fibrillation; CV, cardiovascular; HF, heart failure; PICM, pacemaker induced cardiomiopathy				
*From multivariable logistic regression adjusted for age and eGFR < 45 mL/min/1.73 m²				
°Applies only to patients that did not have previous AF				

Mechanical remodeling

The LVEF decreased significantly more in the RVAP group than in the LBBAP group at follow up. The ΔLVEF was − 0.44% ± 6.3% in the LBBAP group versus − 6.38% ± 6.7% in the RVAP group. In ANCOVA adjusted for age, CKD and baseline LVEF, LBBAP implantation remained independently associated with better ΔLVEF at follow up: −0.55% (CI 95%; -2.24, 1.14) in the LBBAP group vs − 6.28% (CI 95%; -7.91, -4.65) in the RVAP group (p < 0.001), confirming that the observed benefit with LBBAP was not explained by basal differences in our population. The LVEDD also showed a more pronounced decrease with LBBAP, even after age and baseline LVEDD adjustment: −2.14 mm (CI 95%; -3.52, -0.91) in the LBBAP group vs − 0.26 (CI 95%; -1.51, 0.99) in the RVAP group (p = 0.039). Table 4 and Figs. 3 and 4 show echocardiographic outcomes at follow-up.

Table 4
Echocardiographic outcomes at follow up (with Δ values and between-group comparisons)

Echocardiographic outcome	LBBAP	RVAP	p-value
LVEF at FU (%, mean ± SD)	58.5% ± 5.8	53.7% ± 8.6	
ΔLVEF (%, mean; CI 95%)	−0.55% (-2.24, 1.14)	−6.28% (-7.91, -4.65)	< 0.001*
LVEDD at FU (mm, mean ± SD)	45.3 ± 4 mm	47.4 ± 6.3	
ΔLVEDD (mm mean; CI 95%)	−2.14 (-3.52, -0.91)	−0.26 (1.51, 0.99)	< 0.001*
LVEDD, left ventricular end diastolic diameter; LVEF, left ventricle ejection fraction			
*Values adjusted using ANCOVA for age differences			

Analysis based on specific patterns

The LBBAP group was further divided into three subgroups according to fulfillment of the EHRA criteria for LBBAP capture. LBBP capture was adjudicated only under the criteria for definite LBBP capture.

Overall, 35 patients fulfilled criteria for LBBP, 13 fulfilled criteria for LVSP, and 5 met criteria for DSP. No parametric analysis was performed because the groups were too small. A significant overall difference was observed for ΔLVEF when comparing the three subgroups (p = 0.006), indicating a moderate effect size according to the final type of capture. In contrast, no significant differences were found for ΔLVEDD (p = 0.528) or ΔQRS duration (p = 0.101). Post hoc pairwise analyses using Dunn's test with Bonferroni correction demonstrated that the LBBP subgroup showed significantly better preservation of LVEF than the LVSP subgroup (adjusted p = 0.014). However, differences between DSP and LBBP and between DSP and LVSP did not remain significant after correction.

Analysis based on the burden of ventricular pacing

A post-hoc analysis was made to study the importance of the VP burden on the different outcomes in both pacing groups. We further divided all patients in those with a high VP burden (60–90%) and those with a very high VP burden (> 90%). Regarding the ΔLVEF, having a high or a very high VP burden was not significantly different (p = 0.225). Moreover, the interaction between the type of stimulation (LBBP, LVSP or DSP) and the VP burden was not significant (p = 0.692), suggesting that VP burden did not have an effect on the differences of ΔLVEF between groups.

Regarding the incidence of clinical outcomes, in patients with a very high VP burden, PICM incidence and HF admissions were more frequent in the RVAP group than in the LBBAP group: 17.1% vs 0% (p = 0.005), and 19.5% vs 4.7% (0.188), respectively. In patients with a VP burden between 60 and 90%, HF admissions was more frequently observed in RVAP than in LBBAP patients (43.8% vs 0%, p = 0.014), but due to the limited size, PICM was not statistically different (25% vs 0%, p = 0.136;), New onset AF was not analyzed due to the scarce number of patients.

Discussion

In this retrospective cohort of patients with normal or near-normal LVEF who required chronic stimulation for HDAVB, we compared the electrical, echocardiographic, and clinical evolution according to the type of stimulation: RVAP versus LBBAP. Because this was an intention-to-treat analysis, all patients in whom a conduction system pacing procedure was intended were included in the LBBAP group, regardless of the final pacing site. Of these patients, only 5 (< 10%) received DSP and were therefore considered implantation failures, in line with MELOS registry[6].

We defined PICM as a decrease of > 10% in LVEF with a final LVEF < 50%. This is not the only definition, as several cutoffs have been used in this setting[12], and PICM does not always correlate with clinical evolution. Nevertheless, aside from mortality or cardiovascular admissions, PICM is the most important adverse outcome in chronically paced patients because it underlies many of the subsequent clinical complications. However, heterogeneity in the definition of PICM may affect the interpretation of clinical outcomes[12,13]. For instance, in our series, 2 patients were admitted for HF after experiencing a > 10% decrease in LVEF, even though their LVEF remained above 50%.

At 12 months follow-up none of the patients in the LBBAP group developed PICM, regardless of whether strict LBBP criteria for definite capture were met, suggesting that in patients with preserved LVEF, strict fulfillment of LBBP criteria might not be as necessary as in patients with systolic dysfunction. As a matter of fact, when focusing on the different subgroups within the LBBAP group, LBBP showed slightly better performance than LVSP only in preserving LVEF, but no other comparisons, including the evolution to PICM or cardiovascular admissions, were meaningful. Therefore, further studies are needed to clarify the role of LVSP or DSP in patients with preserved LVEF.

At 12 months follow up, LVEF was better preserved in patients undergoing LBBAP than in those undergoing RVAP. These findings were accompanied by improved electrical synchrony and fewer admissions for HF or new onset AF diagnosis. These results are consistent with randomized evidence supporting conduction system pacing[2,6–8]. In the STAY trial, conduction system pacing showed a markedly shorter stimulated QRS than RVAP and preserved LVEF over 6 months (a difference of almost 6% in LVEF), with fewer HF-related admissions[7]. In this retrospective study with a larger sample size, we confirmed these results over a longer follow-up and further evaluated the development of PICM. In the PACE-HF trial, LBBAP not only showed better mechanical preservation in patients with normal LVEF, but also improved systolic function in those with mildly reduced LVEF, together with better clinical evolution and a significant reduction in HF and less new onset AF[8]. In the Prague-CSP trial, CSP also showed favorable trends in clinical outcomes, such as HF admission or the need for CRT upgrade, and although the differences in LVEF between groups were smaller, the incidence of PICM was comparable to that observed in the present study (16% in the RVAP group vs 5% in the CSP group).

Although recent randomized trials included a population with a VP burden of at least 80%, in this retrospective study we have decreased the cuttoff to more than 60% in order to look closer into a population with still a significant amount of VP burden, similar to other previous retrospective studies[14,15]. Our results seem to suggest that a lower foreseen cutoff of 60% or more might be sufficient to adopt LBBAP instead of RVAP.

Conclusions

In patients with HDAVB and normal or near-normal LVEF, chronic stimulation with LBBAP preserved LVEF in contrast to RVAP and prevented from developing PICM. More importantly, LBBAP reduced drastically admissions due to HF events compared with RVAP. Finally, a trend toward fewer new onset AF was also observed with LBBAP. Larger randomized studies with longer follow-up are warranted to confirm these results and to explore the performance of LVSP and DSP, rather than pure LBBP, in patients with normal LVEF.

Limitations

This study was an observational retrospective analysis with operator-based allocation, which may have introduced confounding. Echocardiographic measurements may also have been influenced by inter-

observer variability because multiple imaging operators were involved and were not pre-specified. The sample size was modest and provided limited precision for secondary outcomes. Finally, based on this study, the results should not be generalized to patients with a low VP burden.

Abbreviations

CKD
Chronic kidney disease
CRT
cardiac resynchronization therapy
CSP
conduction system pacing
DSP
deep septal pacing
HBP
His bundle pacing
HDAVB
high-degree atrioventricular block
LBBAP
left bundle branch area pacing
LBBP
left bundle branch pacing
LVAT
left ventricular activation time
LVD
left ventricular dysfunction
PICM
pacemaker-induced cardiomyopathy
RVAP
right ventricular apical pacing
RVP
Right ventricular pacing

Declarations

Ethics approval and consent to participate

The study was approved by the Hospital del Mar Ethics Committee (Registry number 2025/12132), in accordance with the Declaration of Helsinki. Clinical trial number: not applicable.

Consent for publication

Patient consent for publication was not applicable due to the retrospective nature of the study and the use of fully anonymized data.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

G.G.C. drafted the main manuscript, prepared the figures, contributed to statistics, prepared the tables and gathered the data.M.L. conducted the statistical analysis and reviewed the manuscript.C.E.G-M partecipated in conceptualization of the article and reviewed the statisticsP.V.F. reviewed the article for intellectual content and reviewed the manuscript.J.J.L. reviewed the article for intellectual content and reviewed the manuscript.B.C. reviewed the article for intellectual content and reviewed the manuscript.G.G. reviewed the article for intellectual content and reviewed the manuscript.L.J.M. reviewed the article for intellectual content and reviewed the manuscript.E.V. reviewed the article for intellectual content and reviewed the manuscript, contributed to the conceptualization of the work and gave final approval to the version to be published and revised the statistics.All the authors gave approval to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Acknowledgments

The authors have no acknowledgements to declare.

Data Availability

The data used in this study were extracted from patients' electronic medical records and subsequently anonymized in a Microsoft Excel database for analysis. The dataset is available from the corresponding author upon reasonable request, subject to applicable ethical and institutional regulations.

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Figures

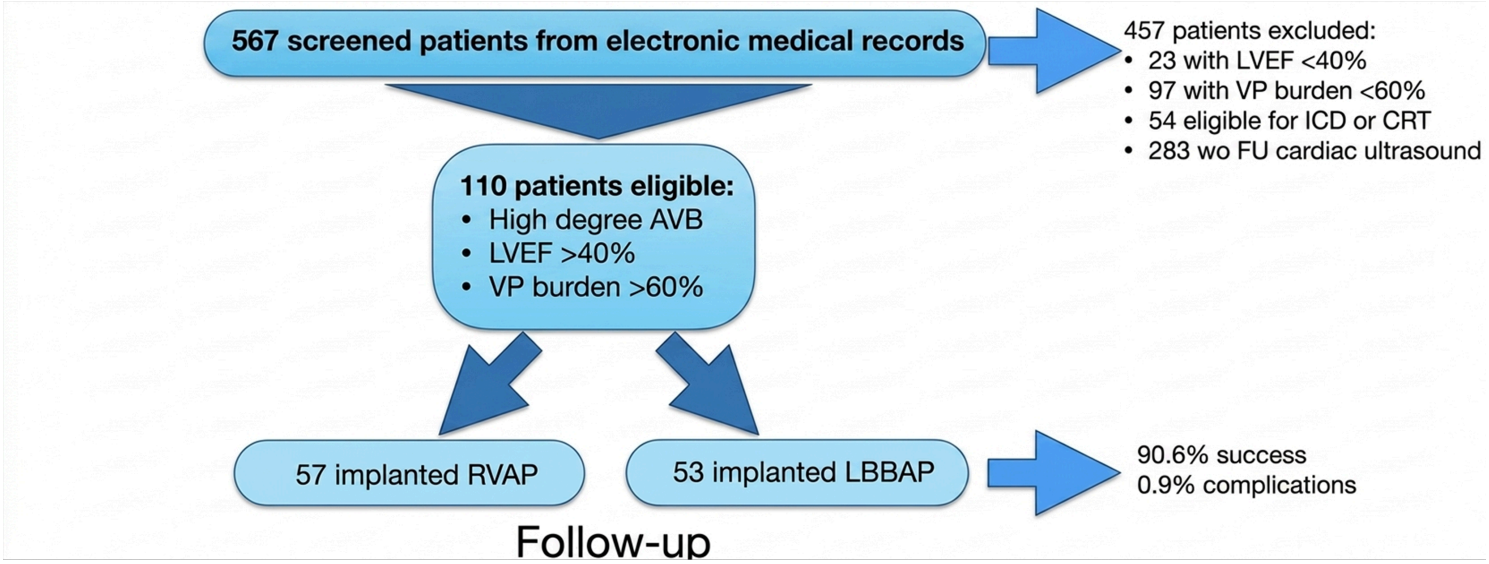


Figure 1

Patient flow diagram showing patients included in each arm and the exclusion criteria.

AVB, atrioventricular block; CRT, cardiac resynchronization therapy; ICD, implantable cardiac defibrillator; LBBAP, left bundle branch area pacing; LVEF, left ventricular ejection fraction; RVAP, right ventricular apical pacing

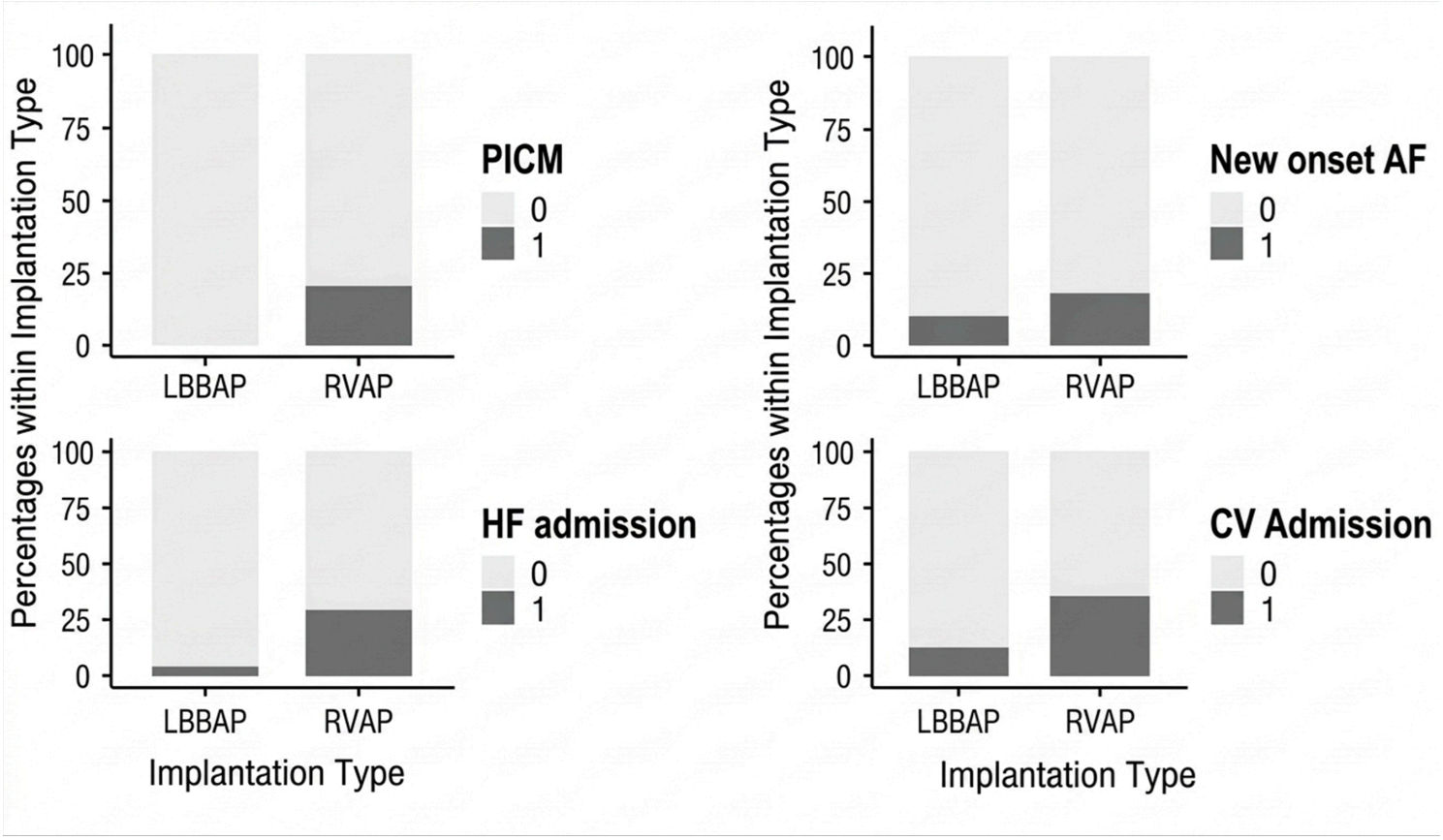


Figure 2

Clinical events during follow-up in each group. Figure 2A shows the follow-up incidence of PICM in each group. Figures 2B and 2C display admissions due to HF and new onset AF diagnosis, respectively.

AF, atrial fibrillation; CV, cardiovascular; HF: heart failure; LBBAP, left bundle branch area pacing; PICM, pacemaker induced cardiomyopathy; RVAP, right ventricular apical pacing

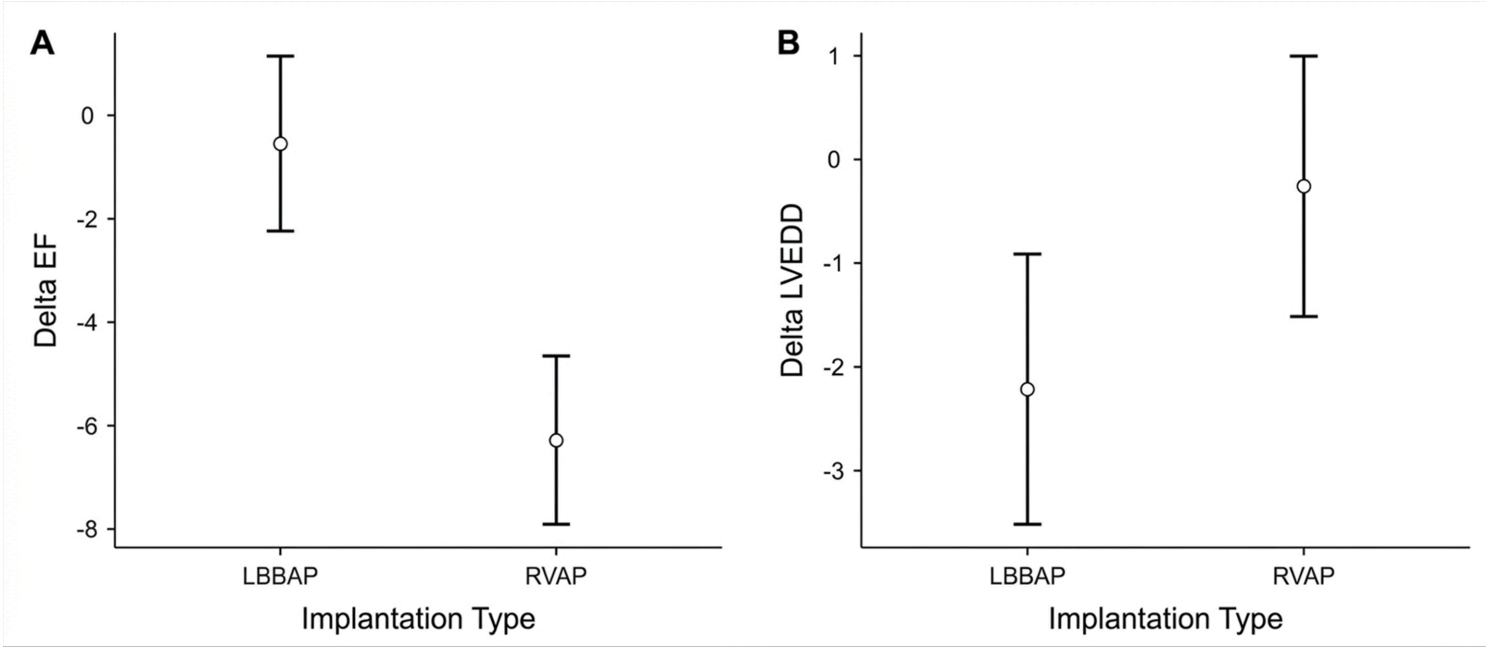


Figure 3

Echocardiographic evolution plots during follow-up in each group. Figure 3A shows ΔLVEF, and Figure 3B displays ΔLVEDD in each group.

EF, ejection fraction; LBBAP, left bundle branch area pacing; LVEDD, left ventricular end diastolic diameter; RVAP, right ventricular apical pacing

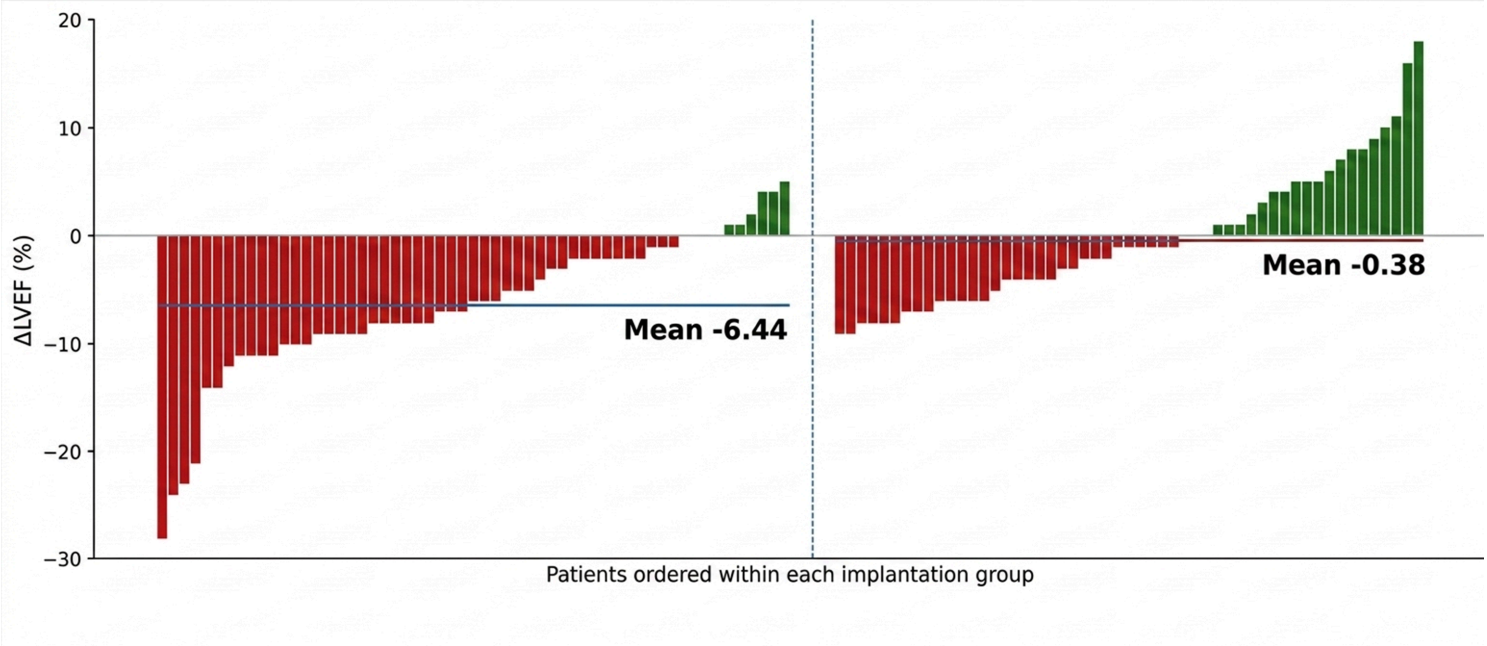


Figure 4

Individual ΔLVEF at follow-up ordered by the magnitude of reduction/gain within both implantation groups. Red indicates a reduction in LVEF, and green indicates a gain in LVEF.

LBBAP, left bundle branch area pacing; LVEF, left ventricular ejection fraction; RVAP, right ventricular apical pacing

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Dataset.xlsx
- Supplementarymaterial.docx