Published in final edited form as:

Pacing Clin Electrophysiol. 2018 September ; 41(9): 1158–1164. doi:10.1111/pace.13425.

Impact of High-Grade Atrioventricular Block and Cumulative Frequent Pacing on Atrial Arrhythmias

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Abstract

Background: The relationship between high-grade AV block (HGAVB) with cumulative frequent pacing and risk of atrial arrhythmias (AAs) has not been well characterized. We hypothesized HGAVB and pacing may have significant impact on incidence and prevalence of AAs by modulating atrial substrate.

Objective: To determine impact of HGAVB and pacing on AAs including atrial fibrillation (AF), atrial flutter (AFL), and atrial tachycardia (AT).

Methods: All consecutive patients who underwent dual chamber pacemaker implantation for HGAVB from 2005 to 2011 at the University of Chicago were included. AAs and percent of pacing were detected through device interrogation. Patients' data were collected from electronic medical records and clinic visits.

Results: A total of 166 patients (mean age 71±15 years; 54% female, 56% African-American) were studied. AF was documented in 27% of patients before pacemaker implantation. During a mean 5.8±2.2 years of follow-up, 47% had device-detected AF, 10% AFL and 26% AT. New-onset AF was documented in 40 of the 122 patients without prior AF (33%). Continuous (99%) right ventricular pacing was associated with significantly decreased AF prevalence (34% versus 59%, p=0.005), and correlated with lower incidence (26% versus 41%, p=0.22). Pacing suppressed AF in 14% of patients with baseline AF; those patients had lower atrial pacing (3.2% versus 45%, p<0.0001). Left atrial dilation was the only independent predictor of AF with frequent pacing (p=0.009).

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Disclosures: None.

Conclusions: HGAVB is associated with high incidence and prevalence of AAs with and without pacing. Cumulative frequent (99%) ventricular pacing reduces risk of AF in patients with HGAVB.

Keywords

Atrial arrhythmias; Atrioventricular block; pacemaker; Atrial fibrillation

INTRODUCTION

Atrial arrhythmias (AAs) and conduction disease requiring permanent cardiac pacing are common clinical conditions encountered in the elderly population.^{1,2} Atrial fibrillation (AF) is particularly prevalent among individuals over age 65 in the United States, affecting 9% of this population.^{1,3,4} AF is associated with multiple co-morbidities including conduction abnormalities and pacing modalities.⁵⁻⁷ Frequent right ventricular pacing (RVP) has been associated with increased rates of AF in patients with sinus node dysfunction (SND); however, the same association has not been consistently demonstrated in patients with high-grade atrioventricular block (HGAVB) treated with dual-chamber pacemaker (DC-PPM) implantation.⁸⁻¹¹ The relationship between HGAVB with cumulative frequent RVP and the risk of AAs requires further characterization to help guide clinical management.

We hypothesized that susceptibility to AAs can be altered by HGAVB and dual-chamber pacing through the effect on atrial electro-anatomical substrate. This study aimed to determine the incidence and prevalence of AAs including AF, atrial flutter (AFL), and atrial tachycardia (AT) in patients with HGAVB requiring frequent pacing. Additionally, clinical and demographic characteristics including race- and gender-specific differences that may facilitate AAs were investigated in this population. In order to determine the impact of cumulative frequent pacing, the prevalence of AF was assessed both before and after initiation of pacing.

METHODS

Study Population

All consecutive patients followed at the University of Chicago Hospital with a DC-PPM implanted between January 2005 and December 2011 for HGAVB were included. Patients requiring RVP <10% and patients without documented DC-PPM interrogation or follow-up beyond the first thirty days of implant were excluded. Also, patients with persistent or permanent AF who underwent single chamber pacemaker implantation were not included in this study group. The patients with cardiac resynchronization therapy (CRT) or CRT-upgrade during the follow-up period were also excluded. Patients were identified retrospectively and followed prospectively. This proposal was approved by the University of Chicago Institutional Review Board.

Data Collection and Follow-up

Electronic medical records were utilized to collect clinical and demographic data. This included detailed notes from inpatient and outpatient encounters, electrocardiograms, Holter

recordings, echocardiographic assessment of left ventricular ejection fraction (LVEF) and left atrial (LA) dilation, DC-PPM implantation procedure notes, and device interrogation reports. Based on echocardiogram, LA size was graded as normal or dilated (moderate to severe dilation). Echocardiography data was available for majority of the patients (69%) before pacemaker implantation. Records were reviewed in detail for baseline patient characteristics including co-morbidities, cardiac structure and function, and presence of AAs. The follow-up period began at the time of pacemaker implantation and ended in November 2016. Patients had standard device interrogation follow-up approximately every three months for the first year followed by every six to twelve months thereafter. DC-PPM was programmed as DDDR. The study included pacemakers from various companies. Total pacing requirements were determined based on the last follow-up device interrogation. Continuous RVP was defined as a 99% pacing requirement. The presence of any AAs lasting 30 seconds as determined by device interrogation during the follow-up period was documented, including AF, AFL, AT, atrioventricular nodal reentrant tachycardia (AVNRT), and atrioventricular reentrant tachycardia (AVRT). Definition of AF and AAs were based on current guideline.¹ AAs were diagnosed based on review of intracardiac electrogram recorded within the device.

Statistical Analysis

Categorical variables were compared between groups using the Fisher's test of independence, while continuous variables compared with student's t-test. Univariate and multivariate associations between AAs and baseline characteristics were assessed by means of logistic regression model. The following variables were considered as potential risk factors for AAs for both univariate and multivariate analyses: age, gender, race, comorbid conditions (hypertension, diabetes, coronary artery disease, chronic kidney disease, obstructive sleep apnea, thyroid disease), LVEF, LA size, and percent of pacing (right atrial (RA) or RV). Statistical analyses were performed using R version 3.3.2.

RESULTS

A total of 166 patients with HGAVB (54% female and 56% African-American) were included in this study. The mean age at the time of pacemaker implantation was 71 ± 15 years (range 22 to 94 years) with a median age of 75 years. African-American patients were significantly older than Caucasians at the time of implant (74 ± 12 versus 67 ± 18 ; $p=0.014$). Also, female patients were significantly older than male patients (73 ± 15 versus 68 ± 15 ; $p=0.039$). There were more African-American women (66%) than Caucasian women (39%) ($p=0.002$). Patients were followed for a mean of 5.8 ± 2.2 years (range 36 days to 11 years) and a median of 5.9 years from the date of pacemaker implantation. Overall duration of follow-up was similar between men and women (5.6 ± 2.3 versus 5.9 ± 2.2 years; $p=0.397$) and between African-Americans and Caucasians (6.0 ± 2.2 versus 5.4 ± 2.1 years; $p=0.134$). Baseline characteristics by race and gender are presented in Table 1.

Clinical Characteristics:

The study population had multiple comorbidities including hypertension (75%), diabetes (26%), renal disease (56%), coronary artery disease (42%), valvular disease (26%) and

others (Table 1). Chronic kidney disease was more prevalent in African-American patients (63%) compared to Caucasians (44%) (OR 2.24 [1.10–4.70]; $p=0.020$). Coronary artery disease was more prevalent in men (51%) than women (34%) (OR 2.00 [1.03–3.93]; $p=0.040$). All other comorbidities were comparable across race and gender.

Cardiac Structure at Time of Implantation:

Mean LVEF at implant was $56\pm13\%$ which was comparable among men and women ($p=0.330$) and different races ($p=0.710$). Almost half of the patients (47%) had a moderate to severely dilated LA. Prevalence of LA dilation was similar across race ($p=0.889$) and gender ($p=0.709$). Underlying characteristics of these subgroups are presented in Table 1.

Prevalence AF Before Pacemaker Implantation:

A total of 44 patients (27%) was found to have documented paroxysmal AF prior to DC-PPM implant. The prevalence of AF at baseline was similar in men (24%) and women (29%) ($p=0.484$). There were no significant differences in rates of baseline AF in African-Americans versus Caucasians (23% versus 33%; $p=0.193$). In a multivariate analysis, hypertension was the only significant independent predictor of AF prior to pacemaker implantation ($p=0.045$). CKD ($p=0.091$) and moderate to severe LA dilation ($p=0.097$) were also correlated with prevalence of AF but did not reach statistical significance. Demographic characteristics and other comorbidities were not significant multivariate predictors of AF prior to implant.

Pacing Features:

All patients received a DC-PPM system. Mean RVP was $78\pm32\%$ and median was 98% in the overall participants. Continuous ventricular pacing (99%) was documented in 82 patients (49%). Lower RVP requirement (10–29%) was present in 29 patients (17%). Overall RVP rate was not different based on race or gender ($p=0.125$ and $p=0.903$ respectively). In total study population, 90% of patients required RA-pacing with a mean rate of $37\pm36\%$ (1% to 100%) and median of 27%.

Prevalence of AAs with Cumulative Frequent Pacing:

During the follow-up period, 78 patients (47%) had at least one episode of device-detected AF, 16 (10%) had AFL, 43 (26%) had AT, and 7 (4.2%) had AVNRT. There was no documented AVRT. Prevalence of post-implant AAs is described by race and gender in Table 2. There was not a significant difference in prevalence of device-detected AAs based on race or gender in this population. In a multivariate analysis, presence of moderate to severe LA dilation prior to implant was the only significant predictor of post-implant AF ($p=0.0001$); however, there was also a correlation noted between post-implant AF and rate of RV-pacing which has not approached statistical significance ($p=0.079$).

Impact of Pacing on Overall Prevalence of AAs:

In patients with pre-implant AF, mean RVP percentage at follow-up was $71\pm33\%$ versus $80\pm31\%$ in those without pre-implant AF ($p=0.094$). Of the forty-four patients with pre-implant AF, 14 (32%) required continuous (99%) pacing post-implant while 25 (57%)

required intermediate (30–98%) pacing and 5 (11%) required low (10–29%) pacing. Mean RVP percentage in patients with post-implant AF was $73\pm33\%$ versus $83\pm30\%$ in patients without post-implant AF ($p=0.044$). The relationship between burden of RV-pacing and post-implant AAs is visualized in Figure 1. Patients with continuous RV-pacing were significantly less likely to have AF post-implant than those with low or intermediate pacing rates; 34% of patients with continuous pacing had AF versus 59% of those with low pacing and 60% of those with intermediate pacing ($p=0.005$). There was no significant association between rate of RV-pacing and AFL or AT in this sample. Patients with continuous RVP had a lower rate of atrial pacing (mean $29\pm32\%$) compared to patients who had less frequent RVP (mean $50\pm36\%$) ($p=0.014$). However, there was no significant difference between mean atrial pacing rate in patients with and without post-implant AF ($42\pm37\%$ versus $33\pm34\%$; $p=0.103$).

Incidence of AF After DC-PPM implantation:

A total of 122 patients did not have any documented AF prior to pacemaker implant. Approximately one third of these patients ($n=40$) developed new-onset AF after pacemaker implant. Nearly half of the overall study group ($n=82$) never had AF before or after pacemaker implant. Characteristics and univariate analyses comparing patients without baseline AF who developed new-onset AF after pacemaker versus patients who never had AF are described in Table 3. The presence of moderate to severe LA dilation was associated with development of new-onset AF (OR 3.96 [1.37–12.07]; $p=0.008$) in this subgroup of patients without pre-existing AF. Gender and other comorbidities were not significantly associated with new onset AF. Continuous RV-pacing correlated with lower incidence of AF (26% vs. 41%, $p=0.223$), though this did not reach statistical significance. In a multivariate logistic regression including demographic data, comorbidities, pre-implant cardiac structure characteristics, and pacing rates, LA dilation was the only significant predictor of incident AF in patients without pre-existing AF ($p=0.009$). Overall percent of RA- or RV-pacing were not independent predictors of AF ($p=0.77$ and 0.39 respectively) in this subgroup of patients.

Suppression of AF After Pacing:

Of the 44 patients who had AF prior to implant, 38 (86%) continued to have AF post-implant while 6 patients (14%) did not have any further device-detected AF. Those who had suppression of their pre-existing AF were less likely to have moderate to severe LA dilation pre-implant ($p=0.003$) and required significantly less RA-pacing (mean $3.2\pm7.3\%$ versus $45\pm39\%$; $p<0.0001$). There was no significant difference in percent of RV-pacing (mean $73\pm43\%$ versus $71\pm32\%$; $p=0.917$). Race, gender, and age at implant were not significantly associated with suppression of AF.

Effect of LVEF on AAs:

In the overall study population, left ventricular systolic function was mildly reduced after DC-PPM implantation from mean LVEF of $56\pm13\%$ to $50\pm13\%$ ($p<0.0001$). Prior to DC-PPM implant, 13 patients (10.1%) had LVEF $\leq 35\%$, while post-implant 21 patients (14.8%) had LVEF $\leq 35\%$. On average, LVEF decreased by $4.8 \pm 11.5\%$ percent between time of implant and last follow-up. A total of 16 patients (14.1%) had a decrease in LVEF of at least

15%. This mild reduction in LVEF was not correlated with percent of pacing; there was no significant association between post-implant change in LVEF and the degree of RA- or RV-pacing based on univariate analysis ($p=0.756$ and 0.854 , respectively). Among patients who had low LV EF ($<35\%$) prior to implant, 4 patients (33%) had improvement in EF to $>35\%$ after implantation.

LVEF was not a predictor for the development of AAs including AF ($p=0.433$), AFL ($p=0.728$), AT ($p=0.456$), or AVNRT ($p=0.197$). Among all patients with paroxysmal AF, mean LVEF was $55.5\pm12.5\%$ prior to DC-PPM implantation and $49.7\pm13.6\%$ at last follow-up ($p=0.004$). Among those who had suppression of AF, LVEF was $62.0\pm7.6\%$ prior to implant and $59.2\pm9.9\%$, which was not statistically significant given the small sample size ($p=1$).

DISCUSSION

In this study, we investigated the interrelation between AAs and HGAVB with cumulative frequent pacing. We found that HGAVB is associated with high incidence and prevalence of AAs before and after chronic pacing in this elderly population. Our main findings include that: 1) AF is present in almost half of the population with HGAVB who required chronic pacing, 2) device detected AFL and AT are also common in this elderly group, 3) new-onset AF is documented one third of the patients after chronic pacing, 4) chronic pacing suppresses paroxysmal AF in a small subset of patients with underlying AF, 5) incidence and prevalence of AF decreases with continuous ($>99\%$) right ventricular pacing, and 6) left atrial dilation is the only independent predictor of AF with chronic pacing.

Our extensive analysis demonstrated that race and gender did not correlate with incidence or prevalence of AAs in our study population. This is a unique observation in patients with HGAVB who required DC-PPM implantation, although it has been reported that AF nearly triples the odds of PPM requirement due to bradycardia more commonly among women and less in African Americans.¹² HTN was a predictor of AF prior to implant whereas moderate to severe LA dilation was the only independent predictor of new onset AF after pacemaker implantation. Patients with continuous RVP ($>99\%$) were least likely to have AF compared to those with intermediate (30–98%) or low (10–29%) percent of RVP. Thus, patients requiring less RVP may require closer follow-up for AAs with device interrogation or remote monitoring. There was no significant association between RVP and other AAs including AFL and AT. There was also a small subset of patients who had at least one episode of documented AF prior to implant but did not demonstrate any device-detected AF after initiation of pacing.

The prevalence of AF among patients with HGAVB and chronic pacing is more than four times the prevalence that has been reported in the general population.¹³ Incidence of new-onset AF after DC-PPM has been estimated at approximately 30% in the literature, which is consistent with our findings.¹⁴ In patients with SND, high rates of RVP have correlated with increased rates of AF, thus there has been some thought that RVP may be arrhythmogenic.¹⁴ However, we found that continuous RVP was actually associated with a decreased prevalence of AF in our study population. We assume that cumulative frequent ventricular

pacing in the setting of HGAVB may help improve AV synchrony and limit arrhythmogenic electroanatomic atrial remodeling in patients with HGAVB, thus reducing risk of AF.^{15,16} Thus, it is perhaps reasonable to adjust pacing settings including rate to provide frequent pacing to reduce risk of AF in a subset of patients. The association between RVP and AF was statistically significant as a univariate predictor of AF prevalence post-implant but not for incidence of new AF in this study.

Atrial pacing was not significantly associated with overall incidence or prevalence of AAs in our study. Yet, there was a strong association between low rates of atrial pacing and subsequent suppression of pre-implant AF. Patients who require higher rates of atrial pacing likely have concurrent SND, which has been independently associated with occurrence of AAs.¹⁷ There has been controversy in the literature regarding the effect of atrial pacing on AF. One meta-analysis comparing patients with bradycardia who had atrial-based versus ventricular pacing found that atrial-based pacing was associated with reduced incidence of AF in that population.¹⁸ Importantly, however, this study did not look specifically at the subset of patients with HGAVB, who inherently require greater RVP. Another meta-analysis of patients with SND found that both atrial and ventricular pacing were associated with higher incidence of AF.¹⁹ There is a paucity of data available regarding the effect of pacing on AAs in patients with HGAVB specifically. In a small subset of patients with HGAVB, we postulate that suppression of AF with appropriate RVP is more likely to occur in the absence of concurrent SND; thus, patients requiring low atrial pacing are more likely to have suppression of AF after pacemaker.

Moreover, we examined the potential impact of cumulative frequent pacing on LVEF in relation to AAs. Although we have found a modest reduction in mean LVEF in the total study group with frequent pacing, post-implant LVEF was not a predictor of AAs. Also, no correlation between LVEF and the degree of RA- or RV- pacing was present in our study group. In the literature, low LVEF has been shown to be both a precipitant of as well as a consequence of AF.²⁰ While patients with pre-existing LV systolic dysfunction experience high rates of LV dyssynchrony with RVP, in patients with initially preserved LVEF clinically relevant decline in LV function after DC-PPM implant is less common.^{21,22} In our study population, the majority of patients had relatively preserved LVEF prior to DC-PPM and only a small proportion had a significant reduction in LVEF after implant. LV systolic function is particularly important in patients with paroxysmal AF since preserved LVEF before and after DC-PPM is associated with suppression of AF.

Indeed, atrial electro-anatomical substrate is essential for development of AAs. The mechanisms by which AF and other AAs affect survival in patients with DC-PPM are not well understood. Although it is not directly evaluated in this study, chronic dual chamber pacing may have significant effect on atrial electro-anatomical remodeling through atrioventricular synchrony or neurohormonal changes or tissue fibrosis. Modulation of atrial electrical property with pacing may affect the incidence and prevalence of AAs. It is likely more important in the elderly population as presented here in our study population. AA is likely a marker of overall atrial disease burden and therefore LA enlargement is the independent predictor of AAs in these patients. Thus, the cellular mechanisms of HGAVB and chronic pacing on atrial remodeling needs further investigation.

Thus, our study shows that RVP does not adversely affect the incidence and prevalence of AF for patients with HGAVB in the long-term; furthermore, it decreases prevalence of AF compared to low or intermediate rates of pacing. It demonstrates that cumulative frequent RVP is an acceptable method for reducing the risk of AF in patients with HGAVB. These observations suggest that electro-anatomical changes in the setting of HGAVB and nature of frequent pacing have an important role in the pathogenesis of AAs in this population, particularly in patients with moderate to severe LA dilation. A subgroup of patients with LA dilation and non-continuous pacing should have closer device monitoring for early detection and treatment of AAs in this population.

Limitations

Our findings should be interpreted in the light of the limitations imposed by a retrospective study design that relies upon on chart review and device interrogations. Selection of the study patients and the control population was not random, but the inclusion of consecutive patients minimized selection bias. Differences in prevalence of AAs pre- and post-implant are affected by the method of AA detection. Silent AF prior to implant may have been undetected until continuous monitoring was available. Device-interrogation data was utilized to assess post-implant AAs; in rare occasions, this is subject to error of atrial sensing that are not clinically significant. The presence of DC-PPM in each patient in our study population provided an accurate data source to assess the incidence of AAs in general. This study did not evaluate the burden of AF, which may have clinical significance in some patients.

Conclusions

HGAVB is associated with high prevalence of AAs, both before and after dual-chamber pacing. Patients with moderate to severe LA dilation have a higher risk of developing AF in this population. However, cumulative frequent (99%) RVP decreases risk of AF in patients with HGAVB.

Acknowledgments

Funding: C. Ozcan is supported by the National Institutes of Health (NHLBI K08 HL 117082).

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Figure 1:

Prevalence of Device-Detected Atrial Arrhythmias by Pacing Percentage^a

^aContinuous right ventricular (RV)-pacing: 99–100%; intermediate RV-pacing 30–98%; low RV-pacing: 10–29%

Table 1:

Baseline characteristics by race (A) and gender (B)

(A)	Total Group (n=166)	African-American (n=93)	Caucasian (n=61)	Asian (n=7)	Hispanic (n=4)	p-value
Mean age at implant, y	71±15	74±12	67±18	70±22	65±14	0.085
Female, n(%)	90 (54%)	61 (66%)	24 (39%)	2 (29%)	2 (50%)	0.004 *
Mean follow-up, y	5.8±2.2	6.0±2.2	5.4±2.1	5.6±2.9	5.4±2.8	0.540
HTN, n(%)	125 (75%)	76 (82%)	41 (67%)	5 (71%)	3 (75%)	0.082
DM, n(%)	44 (26%)	28 (30%)	14 (23%)	1 (14%)	1 (25%)	0.848
CAD, n(%)	70 (42%)	33 (35%)	31 (51%)	5 (71%)	1 (25%)	0.098
CKD, n(%)	93 (56%)	59 (63%)	27 (44%)	4 (57%)	3 (75%)	0.070
OSA, n(%)	18 (11%)	8 (8.6%)	10 (16%)	0 (0%)	0 (0%)	0.431
Thyroid disease, n(%)	24 (14%)	15 (16%)	7 (11%)	1 (14%)	1 (25%)	0.762
Valvular disease, n(%)	43 (26%)	22 (24%)	18 (30%)	3 (43%)	0 (0%)	0.538
Mean LVEF, %	56±13%	56±14%	55±12%	62±13%	58±5.4%	0.710
LAD	54 (47%)	31 (45%)	19 (53%)	2 (29%)	2 (50%)	0.889
(B)	Total Group (n=166)	Female (n=90)	Male (n=76)	p-value		
Mean age at implant, y	71±15	73±15	68±15	0.039 *		
Mean follow-up, y	5.8±2.2	5.9±2.2	5.6±2.3	0.397		
HTN, n(%)	125 (75%)	72 (80%)	53 (70%)	0.150		
DM, n(%)	44 (26%)	22 (25%)	22 (30%)	0.598		
CAD, n(%)	70 (42%)	31 (34%)	39 (51%)	0.040 *		
CKD, n(%)	93 (56%)	51 (57%)	42 (55%)	0.875		
OSA, n(%)	18 (11%)	8 (9%)	10 (13%)	0.455		
Thyroid disease, n(%)	24 (14%)	15 (17%)	9 (12%)	0.683		
Valvular disease, n(%)	43 (26%)	20 (22%)	23 (30%)	0.287		
Mean LVEF, %	56±13%	57±12%	55±14%	0.330		
⁺ LA dilation	54 (47%)	31 (49%)	23 (45%)	0.709		

Abbreviations: HTN, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; CKD, chronic kidney disease; OSA, obstructive sleep apnea; LVEF, left ventricular ejection fraction; LA, left atrium.

⁺LA dilation refers to moderate to severe LA dilation.

* P 0.05.

Table 2:

Prevalence of post-implant atrial arrhythmias by race (A) and gender (B)

(A)	African-American (n=93)	Caucasian (n=61)	Asian (n=7)	Hispanic (n=4)	p-value
AF, n (%)	40 (43%)	33 (54%)	2 (29%)	3 (75%)	0.293
AFL, n (%)	9 (10%)	5 (8%)	2 (29%)	0 (0%)	0.418
AT, n (%)	26 (28%)	16 (26%)	1 (14%)	0 (0%)	0.833
AVNRT, n (%)	2 (2%)	5 (8%)	0 (0%)	0 (0%)	0.366
(B)	Female (n=90)		Male (n=76)		p-value
AF, n (%)	43 (48%)		35 (46%)		0.877
AFL, n (%)	9 (10%)		7 (9%)		0.864
AT, n (%)	21 (23%)		22 (29%)		0.478
AVNRT, n (%)	3 (3%)		4 (5%)		0.704

Abbreviations: AF, atrial fibrillation; AFL, atrial flutter; AT, atrial tachycardia; AVNRT, atrioventricular nodal reentry tachycardia.

Table 3:

Characteristics of patients with and without incident AF

	New-onset AF (n=40)	No AF (n=82)	p-value
Mean age at implant, y	72±16	69±17	0.377
Female, n(%)	19 (48%)	45 (55%)	0.562
Mean follow up, y	7.8±1.5	7.4±1.6	0.144
HTN, n(%)	28 (70%)	62 (76%)	0.518
DM, n(%)	8 (21%)	24 (29%)	0.381
CAD, n(%)	16 (40%)	30 (37%)	0.843
CKD, n(%)	25 (63%)	46 (57%)	0.564
OSA, n(%)	3 (7.7%)	6 (7.4%)	0.956
Thyroid disease, n(%)	6 (16%)	12 (15%)	0.869
Valvular disease, n(%)	10 (25%)	19 (23%)	0.824
Mean LVEF, %	58±12	56±13	0.520
LA dilation	17 (63%)	16 (30%)	0.008*
Mean RA-pacing rate	40±35%	35±34%	0.518
Mean RV-pacing rate	75±34%	83±30%	0.168
Continuous RV-Pacing, n(%)	18 (45%)	50 (61%)	0.223

Abbreviations: HTN, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; CKD, chronic kidney disease; OSA, obstructive sleep apnea; LVEF, left ventricular ejection fraction; LA left atria.

*
P 0.05.