Atrial Fibrillation Inducibility in the Absence of Structural Heart Disease or Clinical Atrial Fibrillation: Critical Dependence on Induction Protocol, Inducibility Definition and Number of Inductions

Running title: Kumar et al.; AF inducibility in a normal heart

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Abstract

Background - Inducibility of atrial fibrillation (AF) after pulmonary vein isolation has been used to guide additional left atrial ablation in paroxysmal AF. The sensitivity and specificity of AF induction in this setting remains uncertain. We examined the incidence and characteristics of inducible AF in patients without structural heart disease or clinical AF and the effect of different induction protocols on AF inducibility.

Methods and Results - In 44 patients with supraventricular tachycardia with no AF or risk factors for AF, atrial refractoriness and conduction were measured followed by AF induction attempts (10/patient). Each induction was performed after waiting time that exceeded twice the duration of induced AF from the preceding induction. AF ≥ 1 min was considered inducible and ≥ 5 minutes as sustained. Burst pacing (at 200ms for 10 s) was compared to decremental pacing (from 200ms to shortest cycle length resulting in 1:1 atrial capture for 10 s). After 10 inductions, AF was inducible in 49.5%, and sustained in 29.5% of patients. The incidence of both inducible and sustained AF increased with each induction. Apart from male gender, no clinical or electrophysiological features were associated with sustained AF. Decremental pacing was associated with a higher incidence of sustained AF (41.2% vs. 14.8% p=0.049), longer duration of AF (p=0.006), and shorter mean AF CL (p<0.001) compared to burst pacing.

Conclusions - Inducible and sustained AF is common in patients in the absence of structural heart disease or clinical AF and its incidence varies according to gender, method of induction and number of inductions. There is a direct relationship between AF persistence and number of inductions, which has not reached a plateau after 10 inductions.

Key words: atrial fibrillation; supraventricular tachycardia; inducibility
Introduction

Pulmonary vein isolation with catheter ablation is a class I indication for the treatment of symptomatic, drug refractory paroxysmal atrial fibrillation (AF). Lack of AF inducibility with rapid atrial pacing has been associated with lower risk of recurrence following AF ablation. Inducible AF has been used to guide further left atrial substrate modification in paroxysmal AF. However, there is considerable heterogeneity between studies in the sites of stimulation, method of stimulation, number of AF inductions, use of pharmacological provocation and in the definition of inducibility based on AF duration. In the first instance, there is very little reference information on the inducibility of AF in a normal heart with rapid atrial pacing. Thus the sensitivity and specificity of the AF inducibility test is difficult to estimate. The aim of this study was to examine the incidence and characteristics of inducible AF in the absence of structural heart disease or clinical AF and the effect of different AF induction protocols on AF inducibility.

Methods

Patients aged 18-65 years with documented or suspected supraventricular tachycardia presenting for catheter ablation were recruited. No patient had a history of structural heart disease as detected by echocardiography and no there was no clinical, ECG, or Holter evidence of AF or atrial flutter. Patients with any co-morbid condition predisposing to AF (e.g. hypertension, diabetes, thyroid, coronary disease, obstructive sleep apnea), sinus node disease or amiodarone use were excluded. All patients with palpitations without documented tachycardia had AF or atrial flutter excluded by undergoing 7-day Holter monitoring. All anti-arrhythmic drugs were ceased > 5 half lives prior to the scheduled procedure. The Melbourne Health Human Research...
Ethics Committee approved the study protocol.

**Electrophysiology study and ablation**

Intracardiac catheters were positioned as follows: (1) 10-pole coronary sinus (CS) catheter (2-5-2 mm inter-electrode spacing) with the proximal bipole was positioned at the CS ostium; (2) a quadripolar catheter with 5-mm interelectrode distance in the His-bundle region; and (3) mapping and ablation catheter. Bipolar intracardiac electrograms and 12-lead surface ECG were recorded simultaneously on a computerized digital amplifier system (EPMed Systems, West Berlin, NJ). Intracardiac electrograms were filtered between 30 and 500 Hz; two authors using on-screen digital calipers at 200 mm/s sweep speed performed the analysis. After the clinically indicated EP study, ablation and isoprenaline washout, the research protocol was commenced.

**Effective refractory periods**

Atrial effective refractory periods (ERPs) were evaluated at twice diastolic threshold at three pacing cycle lengths (600, 500, 400 ms) with an 8-beat drive followed by an extra-stimulus (S2), starting with an S2 coupling interval of 150 ms and increasing in 10-ms increments. Catheters were repositioned if a diastolic threshold <5 mA could not be obtained. ERP was defined as the longest coupling interval that failed to propagate to the atrium. At each site, the ERP was measured 3 times at each cycle length. If maximum and minimum measurements differed by >10 ms, two more measurements were taken and the total was averaged. ERPs were measured at the proximal coronary sinus (PCS), distal coronary sinus (DCS), and RAA.

**Conduction times**

The following conduction times were recorded: (1) conduction time along the CS by pacing the distal bipole of the CS catheter and measuring activation time to the proximal bipole; (2) intra-atrial conduction time by pacing the distal bipole of the ablation catheter in the RAA and
measuring activation time to the atrial electrogram in the PCS; (3) inter-atrial conduction time by pacing the distal bipole of the ablation catheter in the RAA and measuring activation to the atrial electrogram in the DCS;

Conduction was measured at cycle lengths of 600, 500, and 400 ms after stable capture for at least 10 seconds. Conduction time was determined 5 times at each cycle length and averaged. P-wave duration (PWD) in sinus rhythm, measured on lead II of the surface ECG and averaged over 10 beats, was analyzed as a surrogate marker of inter-atrial conduction time.

**Sinus node function**

Sinus node function was evaluated as follows: (1) baseline sinus cycle length was determined over 10 consecutive sinus cycles; (2) corrected sinus node recovery time (CSNRT) was determined after a 30-second pacing drive train at cycle lengths of 600 and 400 ms, correcting for the baseline cycle length. At each cycle length, CSNRT was determined 3 times and averaged.

**AF Inducibility**

AF was induced with pacing from a single site being the PCS at 20 mA and 2 ms pulse width. If induction resulted in AF of ≥ 5 minutes, no further AF inductions were performed because of the known effects of AF on atrial refractoriness. If AF <5 minutes resulted, the next induction was delayed for a period of time greater than twice the duration of last induced AF (e.g. 9 minutes waiting prior to the next induction if AF was induced for 4.5 minutes) The waiting period was employed to ensure recovery of AF-induced shortening in atrial ERP to baseline values. Reversal of AF-induced electrical remodeling is expected to occur over ~5-8 minutes in patients with induced AF > 5 minutes in the absence of structural heart disease or clinical AF. Up to ten inductions per patient were allowed (Figure 1).
AF induction was performed with either burst atrial pacing at a fixed cycle length of 200 ms or by decremental pacing (Figure 2) starting at 200 ms and decrementing by 10 ms to the shortest cycle length that resulted in 1:1 atrial capture along with CS fractionation. At this cycle length, 10 s of pacing was performed. The first 27 patients underwent stable pacing and the next 17 underwent decremental pacing.

A short atrial pacing run was performed (5 s) prior to each induction to measure the shortest cycle length resulting in 1:1 atrial capture. Sinus cycle length immediately prior to each induction was also recorded to examine if change in autonomic tone was a contributor to AF vulnerability.

Analysis of induced AF

AF was defined by the beat-to-beat variability in cycle length and morphology. 4 Total duration and the mean cycle length of induced AF was measured. The AF cycle length was measured in the DCS at a sweep speed of 100 mm/s by averaging 30 consecutive cycles. The shortest and longest AF cycle length was measured within a random 10-second window of induced AF of ≥1-minute duration. Inter-electrogram intervals of ≤100 ms and continuous electrical activity were counted as a single interval. 4

Definitions of inducibility

Patients were classified according to the longest duration of AF induced in any of their inductions. We reported the incidence of inducible AF of > 10 s, 3 ≥1 minute, 2, 6-8, 14-16 ≥5 minutes 17 and > 10 minutes, 4, 5, 18, 19 as per previously used definitions. We considered AF ≥1 minute as inducible and ≥5 minutes as sustained. 11 AF < 1 minute was considered non-inducible and AF 1 to < 5 minutes as non-sustained.
Statistical analysis

The Statistical Package for the Social Sciences for Windows (SPSS, release 15.0, Chicago, USA) and the statistical package “R” (R Foundation, Vienna, Austria) were used for analysis. To test for associations between categorical variables, $X^2$ tests or Fisher’s exact test were used. Mean values were compared using the Student t-test. Mann-Whitney U- or Kruskal-Wallis tests were used for continuous variables where normal distribution was not present.

The incidence of inducible ($\geq$ 1 minute) and sustained AF ($\geq$ 5 minutes) was estimated by use of the Kaplan-Meier method. The Kaplan-Meier method was used firstly as the protocol specified that no further inductions were to be performed if $\geq$ 5 minutes of AF were induced, and second to account for patients with an incomplete set inductions resulting from a lengthy duration of the primary procedure prohibiting full completion of the research protocol due to patient discomfort. Patients were thus censored if, and only if, they underwent $< 10$ inductions and did not experienced sustained AF in any of their inductions.

Cox-regression analysis was performed to determine the predictors of sustained AF. Nine explanatory variables (Table 1) were considered in Cox regression analysis with number of inductions to sustained AF $\geq$ 5 minutes. Grambsch and Therneau test\textsuperscript{20} was carried out for each of the single explanatory variables as a test of the assumption of proportional hazards. Only those explanatory variables with a univariable p-value $<0.2$ were entered into the multivariable model in a backward: likelihood ratio fashion. In all analyses and reporting of results we used patients as the unit of analysis, not inductions.

Shortest atrial pacing cycle length resulting in 1:1 atrial capture prior to AF induction was analyzed by ANOVA with repeated measures. A two-tailed P-value of $<0.05$ was considered statistically significant.
Results

A total of 304 inductions were performed in 44 patients. Baseline characteristics are listed in Table 1. AF > 10s, ≥1 minute, ≥5 minutes, and >10 minutes was present in 34/44, 20/44, 11/44 and 10/44 patients respectively. The incidence of AF > 10s, ≥ 1 minute, ≥ 5 minutes, and >10 minutes was 82.7%, 49.5%, 29.5% and 27.8% respectively. In patients with sustained AF, electrical cardioversion was performed in 5 patients, pharmacological reversion with flecainide in 3 patients and spontaneous termination to sinus rhythm occurred after 10 minutes in 3 patients as preparations for electrical cardioversion were being made.

The shortest cycle length that resulted in 1:1 atrial capture did not change between inductions (p=0.55). Sinus cycle length did not differ between induction (p>0.05 for paired comparisons between inductions). The incidence of inducible AF (≥ 1 minute) within the population studied increased with each induction (1 induction: 9.1%, 2 inductions: 13.9%, 3 inductions: 23.4%; Figure 3a). Similarly the incidence of sustained AF (≥ 5 minutes) within the population studied increased with each induction (1 induction: 4.5%, 2 inductions: 9.3%, 3 inductions: 11.7%; Figure 3b).

There were no significant differences in atrial ERPs, CS conduction, inter-atrial or intra-atrial conduction, corrected sinus node recovery time or P wave duration between the groups (Figure 4). Baseline characteristics of patients with sustained AF vs. non-inducible/non-sustained AF are listed in Table 2. There were a significantly higher number of males, higher body surface area and a trend toward a higher incidence of atrio-ventricular re-entrant tachycardia in patients with sustained AF.

The Grambsch and Therneau test was carried out for each of the single explanatory variable models considered in the Cox regression analysis, and the results were consistent with...
the assumption of proportional hazards (all P > 0.2). Male gender was the only independent predictor of sustained AF in the multivariable analysis (Table 3).

At a mean follow up of 28±22 months (median 23 months, inter-quartile range 25%-75% 11-50 months), no patient had episodes of clinical AF or flutter or recurrence of the index SVT.

**Burst versus Decremental Pacing**

Decremental pacing was associated with a significantly higher incidence of inducible AF ≥ 1 min: 75.5% vs. 32.2%, log rank p=0.002) and sustained AF ≥ 5 min (43.5% vs. 20.5%, log rank p=0.026) compared with burst pacing. Mean AF duration was significantly longer with decremental pacing compared with burst pacing (45±87s vs. 28±63s, p=0.006). Compared to burst pacing, decremental pacing was associated with shorter mean AF CL (176±14 ms vs. 197±22 ms, p<0.001). Mean of the shortest AF CL was lower with decremental pacing compared to burst pacing (136±23 ms vs. 159±24 ms, p<0.001), as was the mean of the longest AF CL (207±19 ms vs. 217±22 ms, p<0.001).

**Discussion**

The main finding of this study was that inducible (≥ 1 min) and sustained AF (≥ 5 min) is common in patients without structural heart disease or clinical AF. Its incidence is critically dependent on the cut off used for its definition (highest incidence with short duration of cut off) and the method of stimulation (higher incidence with decremental pacing). Importantly, AF inducibility increased with the number of inductions performed despite allowing sufficient time for reversal of ERP-remodeling and absence of change in autonomic tone between inductions. The marked difference in the incidence of inducible and sustained AF between AF induction protocols and the relatively common finding of AF in normal hearts suggests that the specificity
of AF inducibility is low.

**Prior studies**

A number of studies have described the use of AF inducibility as an electrophysiological endpoint after PVI to predict long-term outcomes and to determine which patients require additional substrate modification.\(^3,4,6-8\) Non-inducibility predicted greater AF free survival (82-87\%) than for patients who remained inducible over 6-12 months of follow up (42-62.5\%).\(^6-8\) Furthermore, additional linear ablation in patients who remained inducible after PVI increased AF free survival to match that of patients who were non-inducible after PVI alone.\(^5,6\)

In contrast, Richter et al showed that AF inducibility after PVI had a poor sensitivity (46.7\%), intermediate specificity (75\%) and a low positive and negative predictive value for future AF recurrence (53.8\% and 69.2\% respectively).\(^7\) One reason for these differing observations is that the studies have used diverse induction protocols and definitions of AF inducibility.\(^3,4,6-8\)

Following pulmonary vein isolation in patients with paroxysmal AF, rates of AF inducibility varied according to the definition used. Thus it was reported in 43\% of patients for a definition of > 10 s,\(^3\) 14-56\% of patients for a definition of ≥1 minute,\(^2,6-8,14-16\) 36\% of patients for a definition of ≥5 minutes\(^17\) and 7-28\% of patients for a definition of > 10 minutes.\(^4,5,18,19\) In the absence of clinical AF or structural heart disease, we found a higher incidence of inducible AF of > 10s (82.7\%), but similar incidence of AF ≥1 min (49.5\%), of AF ≥5 min (29.5\%) and of AF > 10 min (27.8\%). Importantly, patients with sustained AF (≥5 minutes) did not exhibit changes in atrial refractoriness and conduction to explain AF inducibility. Although, voltage mapping and left atrial measurements were not made, the population in this study were identical
to the controls without AF or structural heart disease in previous studies who were found to have no conduction or voltage abnormalities.\textsuperscript{21, 22}

The number of AF inductions has varied from 2-9 inductions between different studies,\textsuperscript{3-7} and between 3-5 inductions within one study.\textsuperscript{2} We found that the incidence of inducibility increases by each induction and had not yet reached a plateau after 10 inductions. This occurred despite allowing sufficient time for reversal of acute ERP remodeling\textsuperscript{12} and demonstrates an increased probability of AF induction with increasing attempts unrelated to risk of clinical AF. Importantly, none of this cohort developed AF in long-term follow-up.

There has also been considerable heterogeneity in the methods of pacing used for AF induction in prior studies. Some studies have used burst pacing at a fixed cycle length,\textsuperscript{3} while others have paced at the shortest cycle length resulting in loss of 1:1 capture.\textsuperscript{5-8} In the current study we observed that the incidence of inducible or sustained AF was significantly higher with decremental pacing compared with burst pacing, as was the total duration of induced AF. Thus variations in the definition of inducibility, aggressiveness of AF induction protocol, and the number of AF inductions critically influence the use of AF inducibility as a valid electrophysiological endpoint.

Our rate of sustained AF (\textgeq 5 minutes) of 29.5\% was higher than that recent reported by Huang et al (18.6\%)\textsuperscript{11} who also studied an SVT population for AF inducibility after 3 induction attempts. The population in the present study was homogenous with no structural heart disease or risk factors for AF in contrast to Huang et al in which 16\% had hypertension. Detailed electrophysiologic evaluation of atrial refractoriness (three sites), conduction, sinus node function was performed in our study whilst only single ERP measurements from the PCS were reported in that study. Lastly, a large number of AF inductions were performed to elucidate the
incremental relationship between number of induction attempts and inducibility and to
demonstrate no plateau effect in AF inducibility even after 10 attempted inductions.

**Study limitations**

We did not test the effect of pacing from different sites such as the mid or distal CS or RAA on
AF inducibility, nor did we use pharmacological provocation. However, this is unlikely to have
changed the conclusions drawn from the study. We did not test AF inducibility prior to catheter
ablation. Thus the possibility of interaction between substrate for SVT and AF cannot be
excluded. We did not compare burst versus decremental pacing within the same patient, thus
paired comparison was not possible. Due to the long duration of the research protocol, we did not
repeat ERP measurements between AF inductions, which would be most sensitive way to
exclude AF induced electrical remodeling. However, a waiting time that exceeded twice the
duration of induced AF (e.g. 9 minutes waiting between induction for 4.5 minutes of induced
AF) would have been sufficient for ERP reversal, consistent with findings of Daoud et al in
which AF-induced shortening in ERP recovered to baseline in ~5-8 minutes even if AF > 5
minutes was induced.¹²

**Conclusions**

Inducible and sustained AF is common in the absence of structural heart disease or clinical AF.
Its incidence is dependent on both the definition and type of induction protocol used. Critically
we demonstrated a linear relationship between number of induction attempts and inducibility
without observing a plateau effect. These findings suggest that AF inducibility as an
electrophysiological endpoint in the setting of catheter ablation is of limited value.
Acknowledgements: Dr. Kumar is a recipient of a postgraduate research scholarship co-funded by the National Health and Medical Research Council and National Heart Foundation of Australia (Scholarship ID 622896).

Conflict of Interest Disclosures: None.

References:


**Table 1: Baseline characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>N=44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD (yrs)</td>
<td>39±13</td>
</tr>
<tr>
<td>Female gender (%)</td>
<td>68.2</td>
</tr>
<tr>
<td>Body mass index</td>
<td>28±5</td>
</tr>
<tr>
<td>Body surface area (m²)</td>
<td>1.9±0.3</td>
</tr>
<tr>
<td>Symptom duration, mean ± SD (yrs)</td>
<td>5.5±5</td>
</tr>
<tr>
<td>Arrhythmia (%)</td>
<td></td>
</tr>
<tr>
<td>- AVNRT</td>
<td>61.9</td>
</tr>
<tr>
<td>- AVRT</td>
<td>21.4</td>
</tr>
<tr>
<td>- Non-inducible</td>
<td>16.7</td>
</tr>
<tr>
<td>Echocardiographic parameters</td>
<td></td>
</tr>
<tr>
<td>- Left atrial size (mm)</td>
<td>34±6</td>
</tr>
<tr>
<td>- Left atrial area (cm²)</td>
<td>18±4</td>
</tr>
<tr>
<td>- Left ventricular ejection fraction (%)</td>
<td>66±4</td>
</tr>
</tbody>
</table>

AVNRT-atrio-ventricular nodal re-entrant tachycardia, AVRT-atrio-ventricular re-entrant tachycardia, AF- atrial fibrillation, SD- standard deviation, yrs-years
Table 2: Characteristics of sustained AF vs. non-inducible/non-sustained AF

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sustained AF (≥ 5 min)</th>
<th>Non-inducible/non-sustained AF</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, yrs</td>
<td>38±13</td>
<td>40±13</td>
<td>0.7</td>
</tr>
<tr>
<td>Male gender (%)</td>
<td>63.6</td>
<td>21.2</td>
<td>0.009</td>
</tr>
<tr>
<td>Body mass index</td>
<td>29±6</td>
<td>27±5</td>
<td>0.29</td>
</tr>
<tr>
<td>Body surface area (m²)</td>
<td>2±0.3</td>
<td>1.8±0.3</td>
<td>0.04</td>
</tr>
<tr>
<td>Symptom duration, mean ± SD, yrs</td>
<td>4±4</td>
<td>6±5</td>
<td>0.3</td>
</tr>
<tr>
<td>AVRT (%)</td>
<td>36.4</td>
<td>15.2</td>
<td>0.19</td>
</tr>
<tr>
<td>Left atrial size (mm)</td>
<td>33±6</td>
<td>34±6</td>
<td>0.71</td>
</tr>
<tr>
<td>Left atrial area (cm²)</td>
<td>16±0.7</td>
<td>19±4</td>
<td>0.24</td>
</tr>
<tr>
<td>Left ventricular ejection fraction (%)</td>
<td>65±2</td>
<td>66±2</td>
<td>0.79</td>
</tr>
</tbody>
</table>

AF- atrial fibrillation, AVRT- atrio-ventricular re-entrant tachycardia, SD- standard deviation, yrs-years

Table 3: Univariable and Multivariable predictors of sustained AF by cox-regression analysis for sustained AF (≥ 5 minutes)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariable Hazard ratio (95% CI)</th>
<th>P value</th>
<th>Multivariable Hazard ratio (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender*</td>
<td>5.4 (1.5-18.5)</td>
<td>0.008</td>
<td>6.9 (1.8-27)</td>
<td>0.006</td>
</tr>
<tr>
<td>Body surface area (each m² increment)*</td>
<td>4.5 (0.9-24.4)</td>
<td>0.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVRT (vs. others)*</td>
<td>2.5 (0.7-8.7)</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Age</td>
<td>0.99 (0.9-1.1)</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptom duration (each yr increment)</td>
<td>0.99 (0.9-1.0)</td>
<td>0.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>1.1 (0.9-1.2)</td>
<td>0.3</td>
<td></td>
<td></td>
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<tr>
<td>Left atrial size (each 1 mm increment)</td>
<td>0.96 (0.8-1.2)</td>
<td>0.68</td>
<td></td>
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</tr>
<tr>
<td>Left atrial area (each 1 cm² increment)</td>
<td>0.3 (0.04-2.8)</td>
<td>0.31</td>
<td></td>
<td></td>
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<tr>
<td>Left ventricular ejection fraction (each % increment)</td>
<td>0.85 (0.5-1.5)</td>
<td>0.57</td>
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</tbody>
</table>

*inserted into multivariable model. Manifest pre-excitation was not a predictor of sustained AF (hazard ratio 2.0, 95% CI 0.5-7.4, p=0.32).

AVRT- atrio-ventricular re-entrant tachycardia, CI-confidence interval, yr- year

16
Figure Legends:

Figure 1: AF induction protocol. AF was induced from the PCS in all patients at 20 mA pacing output and 2 ms pulse width with pacing at either a fixed cycle length or the shortest cycle length with 1:1 atrial capture for a period of 10 seconds. If sustained AF ≥5 minutes were induced, no further inductions were performed. If AF < 5 min was induced, repeat induction was performed after waiting for a period of time that exceeded twice the duration of the induced AF from the preceding induction. The protocol was completed if sustained AF was induced or 10 inductions were performed.

Figure 2: Burst vs. decremental pacing protocol. Two protocols were compared in the study.

Figure 3: (a): Incidence of inducible AF (≥1 minute) and (b) sustained AF (≥ 5 minutes).

Kaplan-Meier 1-survival plot.

Figure 4: Refractoriness, conduction, sinus node function and P wave duration in the sustained AF vs. non-inducible/non-sustained AF groups. (*representative data shown for 600 ms). There were no significant differences in any of the measured parameters.
AF induction
PCS (20 mA, 2ms) 10 s

Induced AF ≥ 5 min

Induced AF < 5 min

Waiting time ≥ twice the duration of last induced AF

End protocol: 10 ind or AF ≥ 5 min
Burst Pacing (n=208 inductions; 64%)

Decremental Pacing (n=96 inductions, 36%)

200 ms for 10 s

200 ms decrementing till shortest CL with 1:1 atrial capture and CS fractionation (10 s)
(A) ERP (ms)

- Sustained AF: 240, 226, 228
- NI/NSAF: 235, 229, 225

p-values:
- p=0.66
- p=0.74
- p=0.84

(B) Time (ms)

- Sustained AF: 35, 99, 129
- NI/NSAF: 36, 86, 113

p-values:
- p=0.65
- p=0.29
- p=0.13

Site*: DCS, PCS, RAA

Conduction*: CS, Intra-atrial, Inter-atrial
(C)

- Sustained AF
- NI/NSAF

(ms)

<table>
<thead>
<tr>
<th>PWD</th>
<th>CSNRT*</th>
</tr>
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<tbody>
<tr>
<td>99</td>
<td>101</td>
</tr>
<tr>
<td>341</td>
<td>350</td>
</tr>
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</table>

p = 0.83

p = 0.91
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