

# High pre-ablation ECG organization in long-standing persistent atrial fibrillation terminated within the left atrium

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## Introduction

- Stepwise radiofrequency catheter ablation (step-CA) has become the treatment of choice for the restoration of sinus rhythm (SR) in patient (pts) with long-standing persistent atrial fibrillation (LS-pAF).
- Its success rate appears limited as the amount of additional right atrial (RA) ablation to achieve AF termination is unknown.
- Multiple organization indices (OIs) have been used to predict the outcome of step-CA, however with limited success
- Our study is aimed at 1) developing innovative OIs computed from the pre-ablation ECG, 2) evaluating the predictive value of known and new OIs, and 3) identifying the site of AF-term.

## Methods

Clinical characteristics	Study population
Age (y)	60 ± 7
Male/Female	27/2
AF duration (y)	7 ± 5
Sustained AF (month)	19 ± 12
BMI (kg/m <sup>2</sup> )	30 ± 6
LVEF (%)	48 ± 11
LA volume (ml)	173 ± 37

Table 1: clinical characteristics

### Patients Characteristics and Data Acquisition

- 29 consecutive pts (table 1) underwent step-CA (figure 1).
- 1 min ECG epochs for an average duration of 19 ± 7 min per patient were used.
- Chest lead V<sub>6</sub> (V<sub>6b</sub>) was placed on pts' back within the cardiac silhouette to improve antero-posterior recordings of AF.

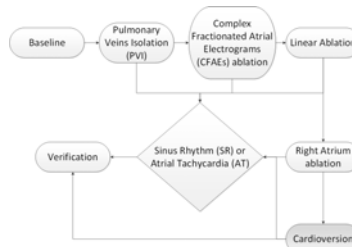


Figure 1: step-CA ablation protocol

### Signal Processing

- Cancellation of QRST waves<sup>1</sup> on all chest leads V<sub>1</sub> and V<sub>6b</sub>. Frequency analysis on the resulting signals using an adaptive tracking scheme (see movie).

### AF Organization Measurements

- **Adaptive organization index (AOI)**: ratio between the power of the extracted adaptive components and the total power of the signal. AOI estimates the temporal cyclicity of the oscillations.
- **Adaptive phase difference (APD)**: variance of the slope of the phase difference (PD). APD quantifies the regularity of the oscillations.
- **AF cycle length (AFCL)**: computed as the inverse of the dominant frequency (largest peak between 3 and 15 Hz in the power spectral density estimate).
- **Spectral organization index (SOI)**: ratio of the power under the fundamental and first harmonic peaks to the total power of the signal<sup>2</sup>.

## Results

### Clinical Results

- AF terminated in 73% of the pts during LA ablation (left terminated pts - LT).
- 8 (27%) pts required RA ablation among which 3 pts had AF-term (right terminated pts- RT) and 5 did not (not terminated pts - NT).
- Table 2 shows the clinical characteristics for the LT and RT/NT groups.

Clinical characteristics	Left terminated LT = 21 (73%)	Right terminated/Not terminated RT/NT = 8 (27%)	p values
Age (y)	61 ± 8	61 ± 4	p = 0.7
Male/Female	19/2	8/0	p = 0.7
AF duration (y)	8 ± 6	5 ± 2	p = 0.1
Sustained AF (month)	17 ± 8	30 ± 17	p = 0.07
BMI (kg/m <sup>2</sup> )	32 ± 6	27 ± 5	p = 0.2
LVEF (%)	44 ± 10	55 ± 10	p = 0.08
LA volume (ml)	179 ± 26	168 ± 47	p = 0.6
Cumulative ablation time (min)	46 ± 17	67 ± 15	p = 0.04

Table 2: clinical characteristics for groups LT and RT/NT. Importantly, all pts displayed similar clinical characteristics, including LA volume, except for the duration of sustained AF and the left ventricular fraction ejection (LVEF).

### AF Organization Measurements

- Figure 3 shows that LT pts were best separated from RT/NT pts before ablation by AOI on lead V<sub>1</sub> and APD on lead V<sub>6b</sub>. SOI was not significantly different between groups. Although AFCL was significantly shorter in RT/NT vs LT pts, the overlap was larger compared to AOI and APD.

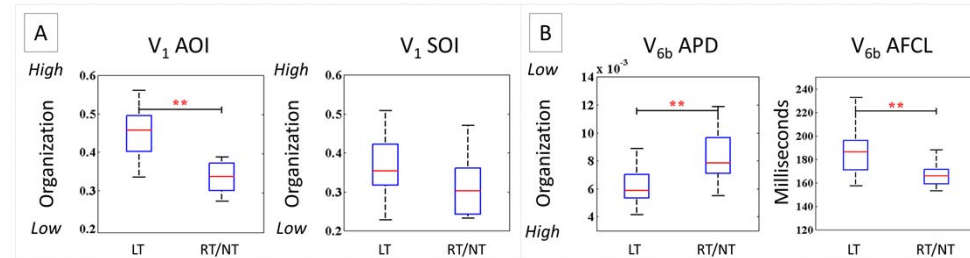


Figure 3: boxplots for the ECG OIs before ablation. Panel A: AOI measured on lead V<sub>1</sub> improved the separation between LT and RT/NT pts, whereas SOI was not significantly different. Panel B: APD and AFCL measured on lead V<sub>6b</sub> revealed a higher AF organization for LT pts, however with a larger overlap of values for AFCL. p < 0.05.

## Conclusion

- Adaptive measures of AF organization computed from pre-ablation ECG perform better than classical OIs for identifying pts whose AF will terminate during ablation within the LA.
- These findings are indicative of a higher baseline organization in LS-pAF terminated within the left atrium that could be used to select best candidates for step-CA.