

High bi-atrial organization in patients with long-standing persistent atrial fibrillation terminated within the left atrium

A. Buttu¹, E. Pruvot², A. Forclaz², P. Pascale², SM. Narayan⁴, P. Maury³, A. Rollin³, JM. Vesin¹

¹Applied Signal Processing Group, Swiss Federal Institute of Technology EPFL, Lausanne, Switzerland

²Department of Cardiology, University Hospital Center Vaudois CHUV, Lausanne, Switzerland

³University Hospital of Toulouse, Department of Cardiology, Toulouse, France

⁴University of California, San Diego, USA



Introduction

- Persistent atrial fibrillation (AF) is maintained by sites displaying high dominant frequency (DF) values.
- Conflicting results were reported regarding the spatial distribution of DF and the existence of a left-to-right atrial DF gradient in patients (pts) with long standing persistent AF (LS-pAF).
- We hypothesized that the pre-ablation bi-atrial DF of LS-pAF pts terminated within the left atrium (LT group) displays smaller value, hence a higher organization, than that of non terminated ones (NT group).

Methods

Patients Characteristics and Data Acquisition

- 26 consecutive pts with a mean LS-pAF duration of 22±13 months (table 1) underwent a stepwise catheter ablation procedure (step-CA) as depicted in figure 1.
- Prior to step-CA, the following catheters (CATH) were introduced via right and left femoral veins :
 1. Quadripolar CATH into the right atrial (RA) appendage (RAA).
 2. Decapolar CATH into the coronary sinus (CS).
 3. Duodecapolar CATH into the left atrium (LA) for DF mapping.
- LA and RA were mapped sequentially as shown in figure 2 (red dotted lines).
- 20-sec epochs were acquired at each location. Each 20-sec epoch was subsampled into non overlapping 4-sec sub epochs.
- The inter-atrial DF gradient was defined as the DF difference between LA and RA appendages.

Clinical characteristics	Study population
Age (y)	61 ± 7
Male/Female	24/2
AF duration (y)	7 ± 5
Sustained AF (month)	22 ± 13
BMI (kg/m ²)	31 ± 6
LVEF (%)	47 ± 11
LA volume (ml)	173 ± 28

Table 1: clinical characteristics

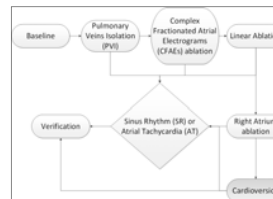


Figure 1: step-CA ablation protocol

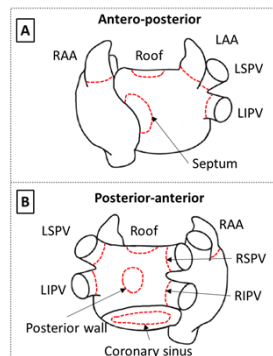


Figure 2: bi-atrial DF mapping.

Signal Processing

- The following spectral analysis was performed¹:
 - Signal rectification.
 - Band-pass (1-20 Hz) Butterworth filter.
 - Frequency spectra calculated by Fast Fourier Transform.
 - DF was defined as the as the largest peak within the power spectrum between 3-15 Hz.
- The DF was computed for all subepochs, averaged, and compared across the two groups (LT vs NT) over all bi-atrial segments within the analysis of variance framework.
- The inter-atrial DF gradient was considered significant if ≥ 1 Hz.

Results

Clinical Results

- LS-pAF terminated in 81% of the pts during LA ablation (LT), and was non terminated (NT) in 19% of the remaining pts in spite of bi-atrial ablation.
- Table 2 shows the clinical characteristics for the LT and NT groups.

Clinical characteristics	Left terminated LT = 21 (81%)	Not terminated NT = 5 (19%)	p
Age (y)	61 ± 8	63 ± 5	
Male/Female	19/2	5/0	
AF duration (y)	8 ± 6	4 ± 2	
Sustained AF (month)	17 ± 8	39 ± 11	p
BMI (kg/m ²)	32 ± 6	27 ± 7	
LVEF (%)	44 ± 10	54 ± 13	
LA volume (ml)	179 ± 26	164 ± 33	
Cumulative ablation time (min)	46 ± 17	65 ± 15	p

Table 2: clinical characteristics for groups LT and NT. Importantly, displayed similar characteristics including LA volume, except for the duration of sustained AF which was significantly different between the two groups.

Bi-atrial Frequency distribution

- Figure 3 shows before ablation that bi-atrial DF values of LT pts were significantly lower than that of NT pts for each LA segments as well as for the RAA ($p < 0.05$).

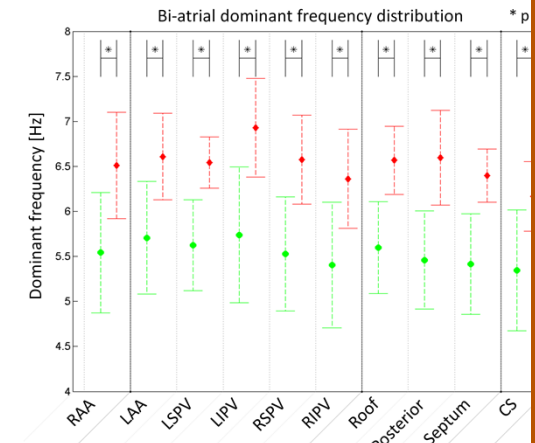


Figure 3: bi-atrial frequency DF distribution before ablation for LT groups. DF bi-atrial values of LT pts are significantly lower than those of NT pts.

Inter-atrial gradient

- No significant LA-to-RA DF gradient was observed both for LT (0.4 ± 0.5 , $p = ns$) and NT (0.3 ± 0.5 , $p = ns$) pts and between both groups.

Conclusion

- The lower DF values of LT pts is suggestive of a higher organization within both atria before ablation compared to NT pts.
- Our findings suggest that low bi-atrial DF values, but not inter-atrial DF gradient, may be of interest for selecting LS-pAF candidates for sinus rhythm restoration by step-CA.