Termination of Atrial Fibrillation by Catheter Ablation can be Successfully Predicted from Baseline ECG

A. Buttu¹, J Van Zaan¹, A. Viso¹, A. Forclaz², P. Pascale², SM. Narayan³, JM. Vesin¹, E. Pruvot²

¹Applied Signal Processing Group, Swiss Federal Institute of Technology EPFL, Lausanne, Switzerland
²Department of Cardiology, University Hospital Center Vaudois CHUV, Lausanne, Switzerland
³University of California, San Diego, USA

Introduction

• Stepwise radiofrequency catheter ablation (step-CA) has become the treatment of choice for the restoration of sinus rhythm (SR) in patients (pts) with long standing persistent atrial fibrillation (LS-pAF).
• Its success rate appears limited as the amount of ablation to achieve long term SR is unknown.
• Multiple organization indices have been used to predict the outcome of step-CA, however with limited success.
→ Our study is aimed at developing innovative indices computed from the baseline ECG (BL, before ablation) in order to predict the outcome of step-CA.

Methods

Clinical Characteristics

• 17 consecutive male pts (60±5 y, continuous AF duration 21±9 months) underwent step-CA consisting in pulmonary veins isolation, left atrial (LA) defragmentation and linear ablations, and right atrial (RA) ablations if non terminated (Figure 1).
• Chest lead V₅ was placed in the back (V₅b) to improve antero-posterior AF recordings.

Signal Processing

• Cancellation of QRS waves¹ was performed on all ECG precordial leads, on which a frequency analysis based on an adaptive tracking was applied.
• Figure 2 illustrates the principle of the adaptive algorithm applied on a synthetic signal for the extraction of the dominant frequency and its first harmonic component over time.

Measurements of AF Organization (Figure 3)

• Adaptive organization index (AOI): ratio between the power of the extracted components and the total power of the signal. AOI estimates the temporal evolution of AF oscillations.
• Variance of the phase difference (PD): variance of the slope of the phase difference (sPD). PD quantifies AF regularity between the dominant and harmonic components.

Results

• LS-pAF was terminated in 13/17 (76%) during step-CA: 11 during LA ablation (LT), 2 during RA ablation (RT), and 4 were non terminated (NT).
• Figure 4 shows that LT was best separated from RT/NT before ablation by AOI on lead V₁ (panel A) and PD from lead V₅b (panel B) as compared to OI and AFCL respectively.

Conclusion

• Our preliminary results indicate that adaptive organization indices computed before ablation perform better than classical indices for separating LT from RT/NT pts.
• These findings are suggestive of a higher baseline organization in patients who can be left terminated compared to patients requiring bi-atrial ablation.