Atrial Fibrillation Spatiotemporal Complexity Is Affected by Pulmonary Vein Isolation

Marianna Meo, Carole Dumas-Pomier, Mélèze Hocini, Michel Haïssaguerre, Rémi Dubois

IHU LIRYC, Electrophysiology and Heart Modeling Institute, Foundation Bordeaux University

Pessac-Bordeaux, France

Introduction Pulmonary vein isolation (PVI) is the cornerstone for paroxysmal atrial fibrillation (AF) ablation, and plays an important role in the treatment of persistent AF as well. However, it is still unclear whether complexity observed on body surface is affected by this intervention. This study aims to evaluate whether PVI has an impact on AF complexity as measured through principal component analysis (PCA) of body surface potential maps (BSPMs).

Methods BSPMs were acquired with a 252-lead vest in 22 persistent AF patients (20 male, 62±11 years, maximum AF duration: 9±18 months) before and after PVI (9±6 s). The atrial fibrillatory wave signal obtained by TQ interval concatenation was divided in 0.5-s segments. In each of them, AF complexity was quantified by the normalized amplitude norm $d_{\boldsymbol{\epsilon}}$ and the cosine similarity $\cos(\alpha_{\boldsymbol{\epsilon}})$ of the multilead error $\boldsymbol{\epsilon}$ between the input signal at the frame *(s)* and its PCA projection onto a 3D subspace computed in the preceding segment *(s-1)*. Furthermore, the nondipolar component index (NDI) measured the fraction of energy non-preserved by PCA in each segment *(s)*. Intraprocedural variations in PCA features were verified through a Mann-Whitney test.

Results A significant reduction in AF complexity was measured by lower NDI and $d_{\boldsymbol{\epsilon}}$ and higher $\cos(\alpha_{\boldsymbol{\epsilon}})$ values ($p<0.0001$, Figure) after PVI.

Conclusions PVI has a significant impact on AF complexity, which can be noninvasively measured by the proposed PCA markers.