An Evaluation on the Clinical Outcome Prediction of Rotor Detection in Non-Invasive Phase Maps

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Background

Electrocardiographic imaging (ECGI) and phase maps have been used in the past for rotor identification and ablation guidance in atrial fibrillation (AF).

Objective

This study proposes a new rotor detection algorithm based on phase singularities (PSs) detection in phase maps. It also evaluates the potential of rotor-related metrics for clinical outcome prediction in patients undergoing pulmonary vein isolation (PVI).

Methods

The performance of the new algorithm was evaluated using real AF episodes. Visually identified rotors were manually labelled using a custom application. Phase maps reconstructed from ECGI signals in 29 patients were calculated prior PVI with and without adenosine injection. Different rotor metrics were calculated and compared between patients that recovered from PVI and patients that persisted in arrhythmia 6 months after ablation. These parameters were calculated using 2 different implementations of the algorithm. In the first one the PSs that did not belong to rotors spinning for at least 1 turn (short lasting rotors) were filtered, and in the second one no filtering was applied to the PS.

Results

The mean precision and recall values of the algorithm were 0.83 and 0.85. A significantly higher concentration of phase singularities was found in the PPVV in patients that recovered from PVI (12.06 vs 6.49%, $p < 0.01$ using adenosine and filtering of 1 turn). In contrast, the number of rotors per second in the atria was higher in patients that did not recover from PVI (66.81 vs 51.13, $p < 0.05$ using adenosine and no turn filtering).

Discussion

The use of adenosine and turn filtering affect the distributions of PSs found in the different atrial regions as well as the number of rotors detected.
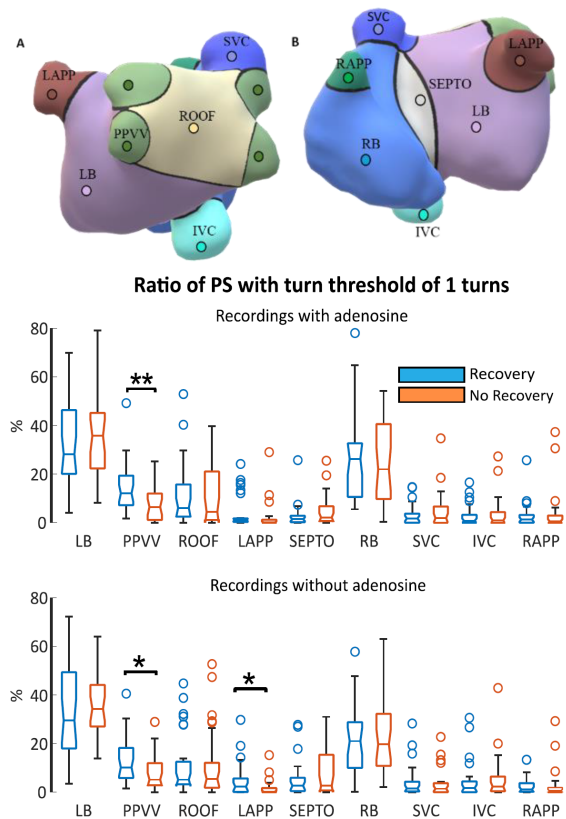

Figure 1: A & B) Front and back view of the atrial model and regional subdivision employed in the analysis. C) Proportion of PSs found in all the defined atrial regions in patients that recovered from PVI (Recovery group) and patients that return to arrythmia (No recovery).

Adenosine seems to reduce the number of regions with a statistically significant difference in the proportion of PS. Furthermore, an increase in the significance of this difference was found in the PPVV when adenosine and turn filtering were combined.

The difference found in the number of rotors between the studied groups became more significance when no adenosine was used and no filtering was applied. The results obtained in this study suggest that rotor-related metrics calculated from phase maps contain relevant information to predict clinical outcome in PVI patients.