

Patterns of Time-Evolving Frequencies on Surface ECG Predict Long-Term Outcome of Ablation in Atrial Fibrillation

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Aims. The presence of a source-dependent atrial fibrillation (AF) following pulmonary veins isolation (PVI) has been shown to be associated with high rates of AF recurrence. We hypothesized that the temporal pattern of the instantaneous frequencies (IF) on surface ECG is predictive of the long-term outcome of wide circumferential PVI (WPVI) in persistent AF.

Methods. 89 patients (65±9y, sustained AF 9±8m) underwent a de-novo WPVI. A second WPVI was performed in patients with recurrent AF in order to provide complete PVI. We defined "success" as patients who remained in sinus rhythm (SR) after one or two procedures, and "failure" otherwise. 60-sec atrial ECG signals devoid of ventricular activity were recorded at baseline and at end of PVI (end_WPVI, before cardioversion). IF was estimated on 60-sec epochs using an adaptive harmonic frequency tracking scheme. For each patient, IF vectors were created by taking the IF samples from all precordial leads at each time instant. Hierarchical clustering of IF vectors into three clusters was performed using linkage method. The median and maximum run-length of clusters on 60-sec epochs were computed.

Results. Over a mean follow-up of 33±10m, 54 patients remained free from AF off antiarrhythmics ("success"), while 26 patients had AF recurrence after 2 WPVIs ("failure"). Figure shows that the median and maximum run-length of clusters at baseline were similar between groups (p=ns). In contrast, at end_WPVI, "failure" group displayed higher median and maximum run-length of IF clusters than those of the "success" group (p<0.05), suggesting the presence post-ablation of more temporally stable frequency patterns in patients unresponsive to WPVI.

Conclusion. The absence of a predominant pattern of AF temporal unfolding following WPVI, as evaluated through clustering analysis of instantaneous frequencies on ECG, is associated with an increased likelihood of freedom from AF after WPVI.

