

Catheter ablation reduces atrial fibrillation organization degree assessed on standard ECG

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Introduction. Selection of candidates to catheter ablation (CA) of long-lasting persistent atrial fibrillation (AF) can be quantitatively correlated to the organization of atrial activity (AA) during AF, based on 12-lead ECG. Complexity is intended as the amount of disorganization observed on the ECG, directly correlated to the number and interactions of wavefronts. AF type classifiers may help selection of candidates to CA. Effect of CA on the complexity of AF may be a first clinical validation of this parameter.

Methods. ECG of 27 patients (pts; 85% men, 60±8 years) who underwent CA of persistent AF were studied. CA was performed with the CARTO system and included a circumferential pulmonary vein ablation, a roof line, a left atrial (LA) isthmus line and electrogram-based ablation of the LA. AA was analyzed by concatenating consecutive TQ intervals (from the end of the T wave to the beginning of the QRS) of 10 s long ECG. AA is modelled as a sum of reference signals (RS) obtained through principal component analysis. The number of estimated RS defines the complexity of the observed signals. Using just 3 RS to reconstruct the observed atrial recordings, signals characterized by low complexity are expected to be better reconstructed. Hence, the higher the complexity of the observed signal the higher the normalized mean square error (NMSE) of its reconstruction from 3 RS. The NMSE is calculated before (NMSE_{pre}) and after CA (or just before end of AF; NMSE_{post}).

Results. AF was stopped by CA in only 7 pts (26%). Another 8 pts (30%) “spontaneously” converted to sinus rhythm during the hospitalization; the remaining 12 pts (44%) needed electrical cardioversion. The analysis of NMSE_{post} vs NMSE_{pre} showed a significant reduction in the complexity of AF after CA ($r_{\text{Pearson}}=0.54$, $p<0.01$), despite persistence of AF in most of the cases. The relation NMSE_{post}<NMSE_{pre}, outlined by the analysis suggests that CA improved the organization in the propagation of the AA.

Conclusion. CA reduces the complexity of AF analyzed on surface ECG, suggesting AF amount of disorganization to be exploited for CA outcome prediction. Whether this relation is predictive of long-term outcome is still to be determined.