Automatic Quality Electrogram Assessment Improves Reentrant Activity Identification in Atrial Fibrillation

Alejandro Costoya-Sánchez*, Andreu M Climent, Ismael Hernández-Romero, Alejandro Liberos, Francisco Fernández-Avilés, Sanjiv M Narayan, Felipe Atienza, María S Guillem, Miguel Rodrigo

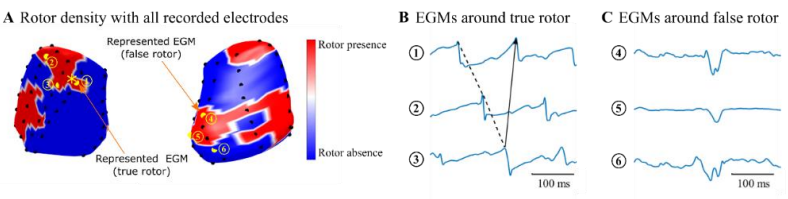
ITACA Institute, Universitat Politècnica de València, Madrid, Spain

Identification and location of reentrant electrical activity driving atrial fibrillation (AF) is essential to ablative therapies. The goal of this work is to study how the quality of the electrograms (EGMs) used for 3D phase analysis can affect reentrant activity localization, as well as to develop an unsupervised method to identify poor-quality signals.

EGM signals from 259 episodes obtained from 29 AF patients were recorded using 64-poles basket catheters and were manually classified according to their quality. An algorithm capable of identifying signal quality was developed using time and spectral domain signal parameters. Reentrant activity was identified as phase singularities in 3D phase maps after EGM phase transform, and the performance of 3D phase-based algorithm was compared to a commercial 2D activation-based method. The effect of EGMs quality was studied by discarding the reentrant activity detected in atrial regions with low-quality EGMs, both manually and automatically marked.

Reentrant activity identified by 3D phase analysis provided an area under the ROC curve (AUC) of 0.69, with a maximum sensitivity of 0.93 and a specificity of 0.28, when compared to reentrant activity detected by the 2D activation-based method. Removal of reentrant activity located in regions with low-quality EGMs significantly improved its performance, increasing the AUC to 0.80, with a sensitivity of 0.92 and a specificity of 0.62. The automatic EGMs quality classification algorithm showed a similar performance than visual signal inspection both for EGM quality classification (sensitivity 0.91 and specificity 0.80) and for 3D phase-based reentrant activity detection (AUC 0.80).

Discard of reentrant activity identified in regions where EGMs showed poor quality improved significantly the specificity of the 3D phase analysis method. Besides, high- and low-quality EGMs automatic identification proved to be possible using time and spectral domain parameters of these signals.



Example of true and false reentries based on EGM quality.