

Discrimination Between CFAEs of Paroxysmal and Persistent Atrial Fibrillation with Simple Classification Models of Reduced Features

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Background. Discrimination between paroxysmal and persistent atrial fibrillation (ParAF vs. PerAF) helps in quantifying atrial remodeling, supports clinical decisions, and suggests adequate approaches for catheter ablation (CA). Previous works proposed several discriminatory strategies, mostly based on dozens of variables assessed with statistical tests. However, in practice, it would be desirable to utilize simple classification models which are readily understandable. This work exploits nonlinear strategies and simple models to discriminate between ParAF and PerAF from recordings of complex fractionated atrial electrograms (CFAEs) of patients undergoing CA of AF.

Methods. A total of 204 bipolar AF CFAEs of 16 seconds in length from the four pulmonary veins (LSPV, LIPV, RSPV and RIPV) and the anterior/posterior (ANT, POS) left atrial free wall, were recorded from patients with ParAF ($n=15$) and PerAF ($n=19$) undergoing CA. We studied dominant frequency (DF), AF cycle length (AFCL), sample entropy (SE) and determinism (DET) of recurrent quantification analysis. AFCL and DF were computed on the whole recording, while SE and DET were applied to segments of 1, 2 and 4s. Redundant information was removed by the correlation matrix (cutoff = 0.6) and Random Forests ranked the variables by relevance. Coarse tree models were built for each segment length, optimally combining high-ranking indexes (score > 40) and were tested on CFAEs using leave-one-out cross-validation.

Results. Due to cross-correlation excess, only just one index from every atrial site was kept by the correlation filter at any segment length. After testing all the possible sets of highly ranked features by the Random Forest, the group SE_{POS} , DF_{LSPV} , DF_{RSPV} and DF_{RIPV} provided the best classification performance with an Accuracy (Acc) of 88.2% for all segment lengths. Aimed at simplifying even more the classification, the highest Acc with a single index was provided by DET_{LIPV} with 82.4% for any segment length as well.

Conclusion. Careful selection of reduced sets of features feeding simple classification models are able to discriminate accurately between CFAEs of ParAF and PerAF, thus providing simplified insights into atrial substrate evaluation and improved therapeutical decisions on AF management.