A KNN Classifier for Predicting Catheter Ablation Responses using Non-contact Electrograms during Persistent Atrial Fibrillation

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Introduction - Identification of atrial sites which are effective ablation targets remains challenging in atrial fibrillation (AF) therapy. The main goal of this work is to use learning algorithm in predicting the responses of ablating electrograms (EGMs) and their effect on terminating persistent atrial fibrillation (persAF) and the cycle length changes.

Methods – A total of 3,206 non-contact EGMs of 51 ablation lesion sites from ten persAF patients (2048-channel Ensite Array) were used. AF cycle length (AFCL) changes before and after ablating each atrial site (a cluster of lesion points) were recorded in Labsystem Pro recording system. A k-nearest neighbour (KNN) classifier was trained using ablation lesion data and deployed in additional 17,274 EGMs that were not ablated. The EGMs were previously classified and labelled in four classes: AF termination; AFCL increase; AFCL unchanged and AFCL decrease. 5-fold cross-validation was considered (80% of the data for training; 20% for validation). Dominant frequency (DF) and organisation index (OI) were calculated from all EGMs (264 seconds) and used as input features of the KNN.

Results – The KNN achieved 85.2% of accuracy in the classification of the four classes. For AF termination classification (Area under the curve (AUC) = 0.98) from all four classes, a sensitivity of 87% and a specificity of 98% were achieved, whilst classifying AFCL increase group (AUC = 0.96) resulted in a sensitivity of 84% and a specificity of 92%.

Conclusions – We have proposed a supervised learning algorithm using DF features and long data duration, which has shown the ability of accurately performing EGM signal classification that could be potentially used to identify ablation targets and become a robust real-time patient diagnosis system.

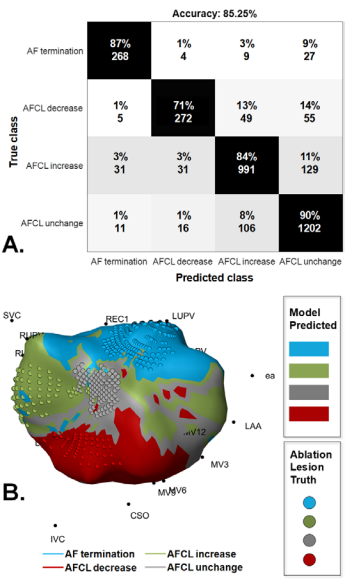

Figure A. Confusion matrix of KNN classifier; **B.** Example of classification