Comparison of machine learning architectures to classify intracardiac atrial electrograms

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While several machine learning (ML) studies have used the ECG to classify atrial arrhythmias (AA) from sinus rhythm (SR), few have used intracardiac Electrograms (EGM). We hypothesized that ML architectures would differ in their accuracy when classifying these rhythms from intracardiac tracings.

Bi-atrial endocardial electrograms of 71 patients at ablation (50 male, 65±11 years) were recorded with 64-pole basket catheters during both SR and AA and labeled by experts. 18±5 EGM channels per patient were divided into non-overlapped 4 seconds segments at 400 Hz (1600 samples), for a total of 25.560 signals. We created 10 cross-validation patient sets randomly allocated 80% for training and 20% for validation.

Signals featurized by *tsfresh* (Python v3.6) and used to train Support Vector Machines classified SR from AA with a c-statistic of 0.93±0.02. Conversely, deep learning using connected (dense) layers using raw EGMs signal as input provided c-statistics of only 0.80±0.07. Architectures using convolutional layers raised this to 0.99±0.01 (2 conv. layers + 3 dense layers, 256/1024/64/64/64 filters, 32/16 kernel sizes). Increasing the number of convolutional layers reduced the accuracy from 0.97±0.02 (2 layers) to 0.91±0.02 (3 layers). For the best CNN architecture, EGM length could be reduced to 1.5 seconds without significantly compromising accuracy (figure).

We conclude that deep learning based on convolutional architectures provided optimal classification of EGMs for AA versus SR, outperforming classic classifiers based on signal featurization. Further studies should examine the extent to which these results can be generalized.