

Prediction of Atrial Fibrillation Disease Progression with Endocardial Electrograms

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Aims: The development of atrial fibrillation (AF) remains poorly characterized and presents an obstacle to differentiating therapies based on its progression over time. Critically, sinus rhythm becomes more difficult to maintain as AF develops. Additionally, it is unclear if there exists significant differences in fibrillatory endocardial conduction over time. This work hypothesized that there are learnable elements in the electrical patterns of fibrillation which predict the length of time in diseased status and aimed to train a deep neural network to perform the analysis.

Methods: Canine paced models of persistent AF were used (n=6). High-density endocardial voltage mapping was performed in the left atrium at 1, 3, and 6-month timepoints post implant during periods of sustained AF using an Orion catheter and the Rhythmia mapping system (Boston Scientific) at several different locations distributed in the substrate. A 50-layer ResNet was trained to predict the timepoint from which random half second atrial electrogram samples were taken. 5 animal datasets with 30000 unique samples were used for training with 1 reserved for testing with 10300 unique samples. Samples were evenly distributed between timepoints.

Results: The deep network was trained over 41 epochs and achieved a final training accuracy of 99% with a loss of 0.57. Testing accuracy was 64% with a loss of 0.66, showing clear improvement over random prediction accuracy of 33%.

Conclusions: This work successfully demonstrated the viability of using deep learning to predict the timecourse of AF from atrial electrograms during fibrillation. This has potential in allowing physicians to differentiate treatments based on longterm AF duration. Additionally, the existence of learnable electrical patterns implies there are unique electrical phenomena specific to developed AF. These unique patterns may help guide therapies. Future work should investigate a larger timepoint range as well as explore viability with clinical electrograms.