Algorithmic Detection of Continuous and Discontinuous Fractionated Electrograms during Atrial Fibrillation

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Introduction: We aimed to develop an automated method to characterize intracardiac atrial fibrillatory electrograms (EGMs) in terms of degree of fractionation. This could be useful to optimize and guide the ablation strategy during atrial fibrillation (AF).

Methods: Thirteen patients with longstanding persistent AF were studied. In each patient, 150±30 bipolar EGMs (2.5s) were recorded during AF. The degree of EGM fractionation (no fractionation, discontinuous fractionation, and continuous fractionation) was visually determined by two experts (gold standard). For each EGM, histogram analysis of the inter-peak intervals (IPI) was performed to calculate the P5, median, P95, mean IPI and the total number (N_{total}) and number of IPI within pre-specified ranges ($N_{10\text{-}60ms}$, $N_{60\text{-}110ms}$).

Results: In total 1681 bipolar electrograms were analyzed. P95, mean IPI, N_{total} and $N_{10\text{-}60ms}$ showed a highly significant linear correlation with the degree of fractionation ($p<0.001$ for all). Each of these parameters could be used to detect continuous fractionated EGMs with a good diagnostic accuracy (AUC >0.8 on ROC curves). $N_{60\text{-}110ms}$ showed a 2nd degree polynomial relation ($p<0.013$) maximizing at the category of discontinuous EGMs. A two-step algorithm

using the median IPI followed by the ratio $N_{60\text{-}110ms}/N_{total}$ provided an objective parameter to detect discontinuous EGMs (ROC curve with AUC >0.7).

Conclusions: (1) Histogram analysis of inter-peak intervals can quantify the degree of fractionation of electrograms during AF. (2) This algorithm is objective, operator independent, and its value in guiding substrate based ablation of AF should be assessed.