

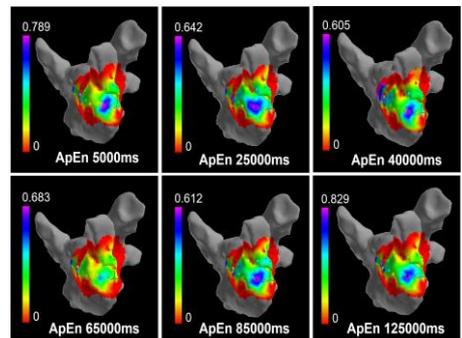
Spatiotemporal Stability of Peak Bipolar Electrogram Entropy Regions in Sustained Human and Animal Atrial Fibrillation (AF): Implications for AF Mechanism and Mapping

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Little exists on the spatiotemporal stability of AF bipolar electrogram (EGM) entropy (En). High En is associated with the spiral wave pivot and wave-break regions. We hypothesize that entropy-based analysis of bipolar EGM stability can provide clinically applicable insights into AF. Our objective was to determine the spatiotemporal stability of Approximate, Sample and Shannon entropy (ApEn/SampEn/ShEn), and compare with Dominant Frequency (DF) in human (H), sheep (S), and computer simulated AF.

Methods: 64-electrode basket bi-atria sustained AF recordings (H:5 mins; S: 20 mins) were separated into 5 second segments and analyzed in Matlab. ShEn/ApEn/SampEn/DF were computed, and co-registered with NavX 3D maps. Spatiotemporal stability was assessed through: (i) global stability by Friedman statistic and bootstrapping; (ii) peak region stability of by Cohen's Kappa, visualized and compared to simulated wave propagation scenarios to provide insight into potential wave mechanisms.



Results: Episodes of AF were analyzed (H:26 epochs, 6,040 secs; S:15 epochs, 14,160 secs). High global spatiotemporal instability of En/DF was observed (coefficient of variation- H:13.42%±4.58%; S:14.13%±8.13%; Friedman: H: P = 0.022±0.01; S: P = 0.0030±0.02). Peak DF regions were relatively unstable (Kappa: H:0.27±0.16; S:0.22±0.18) while peak ApEn/SampEn/ShEn regions relatively stable (Kappa- H:0.67±0.04; S:0.70±0.04). In computational AF, partial stability of highest En region with global AF instability was reproduced with stable rotating waves surrounded by wavelet breakup (Kappa: 0.50±0.16; Friedman: P = 0.025±0.01).

Conclusion: This analysis demonstrates the presence of long-duration partial stability of peak En surrounded by dynamic global spatiotemporal instability. This observation provides a fundamental, clinically applicable potential insight into AF mechanism.