Atrial Fibrillation Episode Patterns and Their Influence on Detection Performance

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Introduction: Existing studies offer little insight on how atrial fibrillation (AF) detection performance is influenced by the properties of AF episode patterns. To take a further step in AF pattern characterization, it is essential to understand how well episode patterns can be captured when using different AF detectors. The aim of this study is to investigate the influence of AF burden and median AF episode length on detection performance.

Methods: Three types of AF detectors, using either information on rhythm, rhythm and morphology, or ECG segments, were investigated. The model for simulating multi-lead ECGs with paroxysmal AF episodes is used to produce two datasets with median AF episode lengths of 30 and 167 beats. Each dataset contains 100 1-h simulated ECGs with AF burden set to 20%, 50%, and 80%, resulting in a total of 300 ECGs.

Results: Comparing AF burdens of 80% and 20% for a median episode length of 167 beats, the sensitivity of the rhythm- and morphology-based detector increases only slightly whereas the specificity drops from 99.5% to 93.3%. The corresponding figures of specificity are 99.0% and 90.6% for the rhythm-based detector, and 88.1% and 70.7% for the segment-based detector. The influence of AF burden on specificity becomes even more pronounced for AF patterns with brief episodes (median episode length set to 30 beats).

AF patterns with brief episodes are best captured by the rhythm- and morphology-based detector. The segment-based detector has the largest sensitivity, however, the detector-produced pattern differs from the reference since a few consecutive episodes are merged into a single episode. On the contrary, both the rhythm-based and the rhythm- and morphology-based detectors tend to split longer AF episodes into clusters, while the segment-based detector does not since it processes ECG segments.

Conclusion: AF patterns with brief episodes and high AF burden imply higher demands on detection performance. Therefore, future research should focus on how well episode patterns are captured.