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Determinanten der Poincaré Plot-Muster von sehr kurzen EKG-Aufzeichnungen

Determinants of Poincaré plot patterns from ECG recordings of very short duration

Summary

Background: Poincaré plots are currently used in qualitative analysis of heart rate variability (HRV), and though the patterns (PoPPs) manifesting on these plots have been defined for 24-hour Holter recordings, they are increasingly used for analysis of short-term recordings. While the principles governing the appearance of highly symmetric PoPPs, such as the torpedo pattern, may well hold for short-term recordings, they may be invalid with respect to more complex morphologies, such as the comet pattern. Thus, it is not known whether, in individuals with normal HRV, a comet shape will manifest in recordings comprising only a few beats.

Objectives: We investigated the PoPPs generated from very short R-R interval series in an attempt to define the spectrum of resulting morphologies and identify their determinants. We specifically tested the hypothesis that a comet morphology arises only in the presence of a sufficiently broad range of R-R intervals and a specific heart rate (HR)-HRV relationship.

Methods: Ten healthy middle-aged (49 - 67 ys) men (n = 6) and women (n = 4) with SR and normal 24-hour HRV underwent a specific test protocol for induction of a broad range of autonomic responses. During the test, ECGs of 15 - 17 min length were recorded from each participant and used as a baseline (NN_base), from which 5 to 7 short segments (NN_seg), each comprising 60 NN-intervals, were randomly selected and submitted to time domain and phase domain HRV analysis.

Results: While the PoPPs generated from NN_base showed a typical comet in all cases, the NN_segs (n = 53) exhibited a comet pattern in 49 %, and a non-comet morphology (i.e. broad ellipse, inverse comet, transitional forms) in the remaining 41 %. The following determinants of the PoPPs observed were identified: 1) Comet: a) large HR range, b) normal instantaneous HRV, and c) a negative quadratic relationship between HR and instantaneous HRV; 2) Inverse comet: a) large HR range; b) normal instantaneous HRV, and c) a negative logarithmic relationship between HR and instantaneous HRV; 3) Elliptical and other non-comet patterns: a) normal instantaneous HRV, b) small HR range, c) no correlation between HR and instantaneous HRV.

Conclusions: In individuals with normal HRV, ECG recordings comprising 60 R-R intervals produce various Poincaré plot patterns that reflect different relationships between heart rate and instantaneous HRV. A typical comet shape will arise only in the presence of a large HR range and a nonmonotonic relationship between HR and beat-to-beat variability. The physiologic processes underlying these observations deserve further elucidation.