Inhomogeneous HRV Spectral Complexity: a Preliminary Evaluation with Gravitational Stimuli under Selective Autonomic Blockade

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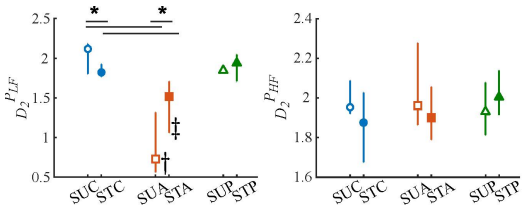
Background and Aim: Nonlinear Heart Rate Variability (HRV) analysis has been successful for the assessment of autonomic nervous system (ANS) regulation of heartbeat dynamics in health and disease. Nevertheless, nonlinear assessment of other HRV-derived series, such as HRV time-varying spectra, has not been performed yet. To this end, here we introduce the *spectral complexity* framework characterizing the dynamics of HRV spectral components, typically related to sympathetic and parasympathetic regulation, by a paradigmatic application on postural changes in healthy subjects undergoing selective ANS blockade.

Methods: Correlation dimension, D_2, and maximum approximate entropy $ApEn_{max}$, were calculated on instantaneous LF (0.04-0.15 Hz) and HF (0.15-0.45 Hz) series, as well as their normalized versions, derived from a point-process model for heartbeat dynamics. Control (C) and pharmacological ANS blockades with atropine (A) or propranolol (P) were evaluated in 7 subjects during supine (SU) and standing (ST) positions.



D_2 computed over instantaneous $P_{LF}(t)$ and $P_{HF}(t)$. * represents statistical significant differences between SUX and STX, where X ∈ {C (control); A (atropine); P (propranolol)}. † SUA, SUP vs. SUC, and ‡ STA, STP vs. STC. p-value < 0.05 is considered as significant.

Results: Complexity quantification of instantaneous LF component using D_2 revealed significantly higher values in standing than in supine position under atropine, i.e. vagal blockade, but not under propranolol (figure), which is in contrast to the results found under control conditions. Qualitatively similar changes were found for $ApEn_{max}$. Conversely, no statistically significant differences were found in the nonlinear indices evaluated for the HF component, either for standing vs. supine or blockades vs. control conditions.

Conclusions: The proposed methodological framework enriches the current knowledge on complex ANS regulation of the heart, supporting the fact that previously reported reduction in cardiovascular complexity during postural changes is mainly vagally driven.