Reduced RR Interval Correlations of Long QT Syndrome Patients

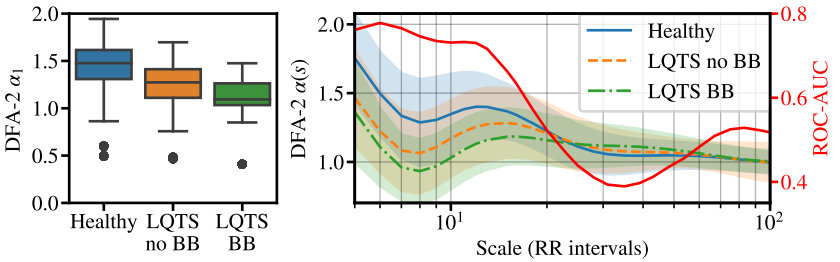
Teemu Pukkila, Matti Molkkari, Jiyeong Kim, Esa Räsänen

Computational Physics Laboratory, Tampere University
Tampere, Finland

Aims: We study RR interval (RRI) correlations in subjects with long QT syndrome (LQTS), which is a genetic condition delaying myocardial repolarization. Our aim is to find distinctive differences in nonlinear heart rate variability (HRV) measures between the LQTS subjects and healthy controls. The previous studies have been inconclusive in this respect, which we aim to overcome by analyzing a larger sample of subjects.

Methods: We analyze 24-hour Holter recordings measured during normal daily activity and the LQTS patients are genetically diagnosed. After discarding poor quality recordings and unifying the age distributions of the two groups we are left with 129 healthy controls and 118 LQTS subjects. Beta blockers (BB), which are known to affect HRV, are a common treatment for LQTS patients, and that is the primary confounding factor that needs to be accounted for. We compute conventional short-scale (4–16 RRIs) detrended fluctuation analysis (DFA) scaling exponents α_1 at various degrees of detrending. We complement the study by investigating scale-dependent exponents $\alpha(s)$.

Results: We find statistically significant reduction in the short-scale α_1 of LQTS for subjects with (Student's-t test p-value $< 4.5 \times 10^{-13}$) and without ($p < 2.2 \times 10^{-8}$) beta blockers. These DFA-2 results yield considerable improvement over the linear detrending of DFA-1. In the scale-dependent picture we find that the differences in the correlations are predominantly manifested at shorter scales and beyond approximately 20 RRIs the behavior converges among all the groups. The clear differences in the mean behavior between these groups are overshadowed by substantial individual variability, which is evident by the wide distributions of the α values. Despite the overlapping distributions the scaling exponents provide limited predictive power, and maximum distinguishability is achieved with DFA-2 at the scale of 6 RRIs with receiver operating characteristic (ROC) area under curve (AUC) score of 0.78.



Short-scale DFA-2 scaling exponents α_1 for healthy and LQTS with and without BB (left). Scale-dependent DFA-2 scaling exponents $\alpha(s) \pm$ S.D. along with ROC-AUC for healthy versus combined LQTS groups (right).