Unique RR Interval Dynamics Preceding Sudden Cardiac Death

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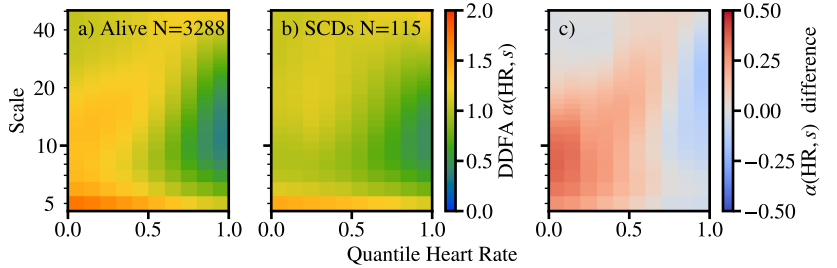
Aims: Sudden cardiac death (SCD) is often the first manifestation of underlying cardiac pathology, emphasizing the importance of early detection. We study how dynamical RR interval (RRI) correlations change between SCD and non-SCD subjects during clinical exercise test.

Methods: We analyze RRIs extracted from Mason–Likar modified 12-lead ECG recordings during a clinical exercise test (N=3848) from FINCAVAS database. During the follow up period of 8.3 years (IQR 6.4–10.5) 115 subjects suffered an SCD. We evaluate the dynamic scaling exponent $\alpha(t, s)$ as a funtion of scale s and time t – an effective measure of RRI correlations – of dynamic detrended fluctuation analysis (DDFA). Eight confounding factors were taken into account with multivariable Fine–Gray subdistribution hazard model and other causes of death (N=445) were modeled as competing risks.

Results: Different scale and time dependent dynamic scaling exponent $\alpha(t, s)$ aggregated as a function of scale and heart rate (HR) show differences between the alive and SCD groups. The most prominent univariate hazard ratio of 0.45 (95% CI 0.37–0.55, $p = 2 \times 10^{-15}$) obtained with scale 8 and quantile heart rate 0–0.1. This corresponds to a 2.2-fold risk of SCD compared to alive population with one standard deviation decrease in the DDFA scaling exponent. Similarly, the smallest multivariable hazard ratio is 0.57 (95% CI 0.46–0.72, $p = 1 \times 10^{-6}$) for the corresponding scale and HR. In conclusion, SCD patients show decreased $\alpha(\mathrm{HR}, s)$ at low quantile HRs and increased $\alpha(\mathrm{HR}, s)$ at high quantile HRs to some extent caused by lower maximal HR.



DDFA $\alpha(\mathrm{HR}, s)$ aggregated over the subjects a) alive, b) sudden cardiac death (SCD) during the follow-up period, and c) the difference between a) and b).