

Heart Rate Variability Characterized by Refined Multiscale Entropy Applied to Cardiac Death in Ischemic Cardiomyopathy Patients

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The dynamics involved in the beat-to-beat variability of the heart occur over a large set of temporal scales. Due to this multiscale behavior, heart rate variability (HRV) cannot be completely characterized on a single time scale, and scaling techniques are required to characterize its behavior. Refined Multiscale Entropy (RMSE) was proposed as a refinement of Multiscale Entropy (MSE) since it offers a way to solve two shortcomings that produce the MSE dependence on variance and on the shape of the power spectrum of the considered series. In this work, RMSE was applied to characterize risk of cardiac mortality (CM) in ischemic cardiomyopathy patients, analyzing HRV by means of RR series of 24h holter-ECG during daytime and nighttime. The end-point was age-matched patients that suffered CM after a follow-up of three years. The study considered 30 patients with CM as high risk group and 192 survivor patients (SV) as low risk group. RMSE approach that takes into account an abroad range of time scales (τ) was based on: a) elimination of the fast temporal scales using antialiasing low-pass filter to focus progressively slower time scales; b) coarse graining procedure necessary to assess entropy rate; c) calculation of the entropy rate that was approximated by sample entropy. RMSE showed statistically significant differences ($p < 0.05$) during daytime and nighttime only in middle time scales ($\tau = 4-15$). For these scales, RMSE was higher in SV group than in CM group. These indicated a reduction of the entropy-based complexity in high risk group when it was compared with low risk group. No statistical differences between SV and CM groups were presented at time scale $\tau = 1$ (unfiltered original RR series). It can be concluded that the dynamics in middle time scales should be considered to better describe the HRV of patients with CM.