

## U-shaped patterns in HRV from a polysomnographic point of view: a quantitative analysis

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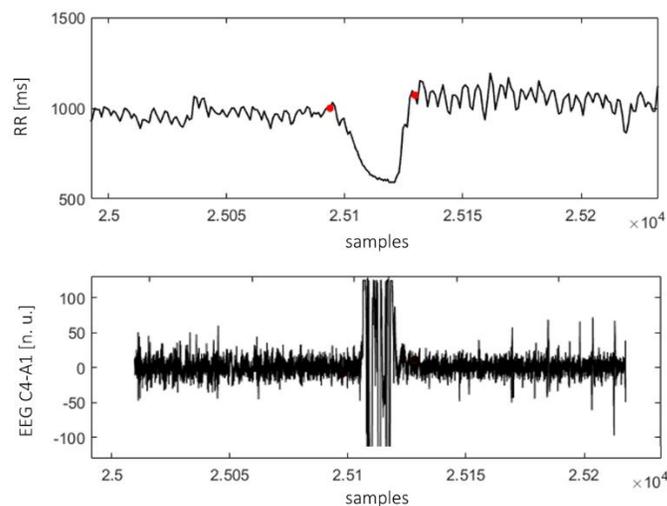
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U-shaped patterns are acceleration-deceleration periods in RR interval series, observed mostly during sleep. These relatively short time events (average duration  $29.8 \pm 4.1$  s) are the most laminar structures in the night-time recordings. The phenomenon is different from the well-known HRV asymmetry observed by Porta et al. Previous studies showed that these patterns have a considerable impact on the HRV parameters describing the VLF component, persistency, nonlinear correlations and multifractal properties, although their percentage contribution is small compared to the whole night-time series (on the average  $3.1 \pm 1.7\%$ ). The aim of this study is a quantitative analysis of sleep events occurring during U-shaped patterns in polysomnography recordings obtained from Sleep Heart Health Study database.

500 polysomnography recordings were analyzed and included 244 male and 256 female adults (>40 years old). RR interval series were extracted from ECG recordings and the U-shaped patterns were detected and categorized based on sleep stages, body position, respiratory events and EEG arousals. 4202 U-shaped patterns were found in 463 recordings with a mean value of 8.4(7.7) per patient. The majority of U-shaped patterns coincide with EEG arousals (74%). 48% of the patterns occurred at sleep phase changes. Most of the U-shaped patterns were associated with the Wake phase (63%). U-shaped patterns occurred at different body positions: supine – 26.0%, prone – 22.4%, right – 15.2%, left 14.3% and at the position changes – 22.6%. Analysis of respiratory events showed that U-shaped patterns occurred during hypopnea in 33% of the cases, central apnea - 2%, obstructive apnea - 1% and desaturation – 19%.

The quantitative analysis of polysomnography recordings is a first step to discover the origin of the phenomenon of U-shaped patterns. These first observations show that the U-shaped patterns occur for different conditions during sleep and could be difficult to explain by a single physiological mechanism.



Example of U-shaped patterns observed in RR time interval series and EEG arousal.