ASYMMETRY IN RESPIRATORY SINUS ARRHYTHMIA

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Objectives: Respiration sinus arhythmia (RSA) is a well known mechanism that affects heart rate variability. On an electrocardiogram this phenomenon is manifested as *subtle* changes in the R-R interval which are synchronized with respiration. The R-R interval is shortened during inspiration and prolonged during expiration. RSA is commonly quantified using frequency domain approaches, for example, by examining cross-spectral phase delays. It is worth pointing out that all methods based on Fourier analysis share the very same limitation. In particular, the relationship between cardiac acceleration and inspiratory timing is represented in terms of symmetrical basis functions (sinusoids). However, it has been suggested that the relative positions of cardiac acceleration and deceleration within the respiratory cycle may change in an asymmetrical manner under varying conditions (Sin, P. Y. W., Galletly, D. C., & Tzeng, Y. C. (2010). *American Journal of Physiology. Heart and circulatory physiology*, *298*(5)). In this work we test this hypothesis using data from awake and sleeping subjects. **Subjects:** The interplay between hear rate variability and respiration was investigated in the cohort of twenty young (21 - 34 years old) healthy volunteers (Fantasia Database, www. physionet.org). The ECG and respiration signals were acquired during 120 min supine rest. The subjects watched the movie Fantasia (Disney, 1940) to help maintain wakefulness. In addition, the standard polysomnography was performed for 3 healthy young subjects during two consecutive nights. Respiration effort was monitored with two belts placed at thorax and abdomen. ECG was acquired using a single lead. **Methods:** The computer generated R-R time series were visually verified to eliminate motion artifacts. The relationship between cardiac acceleration and inspiratory timing was analyzed in the neighborhood of points where the length of the consecutive R-R intervals increased by more than 25%. **Results:** In 11 out of 20 awake subjects we discovered significant number (>10) a sudden cardiac deceleration which may take place either at the end of inspiration or the onset of expiration. We dub such change as an R-R jump. In three subjects the number of jumps exceeded 100. Hundreds of such jumps may be observed during sleep. **Conclusions:** Carl Ludwig is generally credited with the first description of respiratory sinus arhythmia in 1847. Since his discovery RSA has been perceived as subtle changes in the length of R-R intervals synchronized with respiration. In this work we demonstrated the existence of R-R jumps – abrupt cardiac deceleration triggered at the end of inspiration or the onset of expiration. In other words, cardiac acceleration and deceleration within the respiratory cycle may not after all be symmetrical. We observed the R-R jumps in awake subjects, and during stage 2,3,4 NREM and REM sleep. Further research is needed to elucidate the RSA dynamics.