Measurement of breathing frequency from ECG in the examination of autonomous nervous system activities: Suggested methods and their verification

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Abstract

From a wide range of methods pertaining to breathing frequency measurement we opted for the less frequent method of breathing frequency diagnosis originating from the assessment of changes in ECG signal parameters pursuant to changes in thoracic volume during expiration and inspiration. The principal reason for selecting this method was in the fact that in the assessment of autonomous nervous system (ANS) activity the ECG signal is monitored and this can also be used for diagnosing breathing frequency. Changes in ECG signal parameters were analysed by the method of spectral analysis of heart rate frequency (BFrr), the method of spectral analysis of variability amplitudes of QRS complexes (BFqrs) and time analysis of periodicity in amplitudes changes of QRS complexes (BFv) in order to suggest the optimal method of measuring breathing frequency. Monitoring of the ECG signal and calculation of ECG parameters, including the mentioned analysis, were processed by the VarCor PF6 system with modified programme equipment. Statistical verification of the selected method and recommendation of the optimal method for breathing frequency measurement was carried out with the help of reference values of breathing frequency at 9 and 12 cycles/min that were via acoustic signals transmitted to the tested subjects. Characteristics of the sample set: 55 men and women aged 22.7 ± 2.4 years, measurement was done in the positions supine 1 – standing – supine 2, the total number of statistically processed sets was n = 118. Based on the statistical results where the significance of differences between average values regarding reference values were tested by t-test and furthermore, based on the calculation of values based on absolute differences between breathing frequencies, the BFqrs method was recommended since it allows for diagnosing breathing frequency in the range of 6–25 cycles/min. The designed method will be applied to the existing algorithm of the diagnostic system VarCor PF6, thereby helping to specify the interpretation of the results of ANS examination.

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