ANALYSIS OF CARDIORESPIRATORY COUPLING IN ATHLETES IN REST USING CAUSAL APPROACH

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In sports medicine the ECG-based analyses are well established, however they usually do not consider the mutual influence of respiratory and cardiac activity. The aim of the study was to analyse cardiorespiratory coupling using Granger causality test and the best shift between RR intervals (tachograms) and tidal volume (TV) signals in rest. 105 elite athletes performed 5-minutes-lasting free breathing in supine body position. Respiratory and cardiac signals were registered using impedance pneumography and ECG. RR intervals and TV curves were established and taken for further analyses. The Granger causality test statistics and best shift for each participant were calculated, together with the determination coefficient (R2) of the linear model between tachogram and TV after applying the adjustment. ANOVA was used to estimate the significance of each demographic parameter. Treatment of both tachogram and TV signal as the cause of change of the second signal in terms of shape was statistically significant in all cases ($p < 0.0001$, higher statistics of Granger causality test while assuming tachogram as the cause). Concerning physiological intuition and the convention, in which the beginning of inspiration is found as maximum of TV signal, and taking into account the results only for arbitrarily set $R2 > 0.2$, the best adjustment was a positive tachogram's shift by 296 +/- 264 ms. No demographic parameter had significant effect on the differences between Granger causality tests and the best shift between RR intervals and TV signals. It seems that our new device, Pneumonitor, provides the opportunity to assess both respiratory- and cardiac-related signals, without affecting the natural functioning of the subject. Further cardiorespiratory relationship analyses will include spectral and econometrics approaches.