Sensitivity and Frequency Coupling Indexes of Respiratory Sinus Arrhythmia in Response to Continuously Increasing and Decreasing Tidal Volume

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In a previous study we proved that our proposed indexes of respiratory sinus arrhythmia (RSA) sensitivity (RSA_S), frequency (RSA_FC) and power (RSA_PC) coupling better elucidated the mechanism of chirped breathing effects on RSA. Now, in 25 healthy subjects, we compared the effects provoked by combining continuously increasing and then decreasing tidal volume (VT, 0.5-2.5 l) with chirped respiratory frequency (RF, 0.15-0.5 Hz) versus those of the same chirped RF at fixed VT (0.8 l) on the instantaneous 45-s time-courses of central frequencies and powers of high-frequency components (CF_HF, pHF) of RR intervals (CF_HF_RR and pHF_RR) and respiration (CF_HF_RES and pHF_RES), estimated by a time-frequency distribution. We used the CF_HF_RES-CF_HF_RR relation and their difference (ΔCF_HF) as RSA_FC indexes, pHF_RR/pHF_RES coherence (RSA_CO) as RSA_PC index, and √(pHF_RR/pHF_RES) as RSA_S. The combined VT-RF maneuver provoked, in relation to the chirped RF maneuver: 1) accentuation of the progressive reduction of RSA_S dynamics, shown by their smaller (p<0.04) mean values at 7.5, 15, 22.5 and 30s; 2) smaller (p<0.04) slope and intercept of the CF_HF_RES-RSA_S relation; 3) smaller (p<0.04) 15, 22.5 and 30s means of RSA_CO dynamics; 4) greater (p<0.001) 7.5,15 and 22.5s means of CF_HF_RR dynamics; 5) greater (p<0.02) intercept and smaller (p<0.04) slope of the CF_HF_RES-CF_HF_RR relation; 6) smaller (p<0.04) 15 and 22.5s means and larger (p<0.002) 7.5 and 30s means of ΔCF_HF dynamics.

Our findings support that 0.5-2.5 l increasing-decreasing VT provokes an important depression of RSA_S and RSA_PC measures in the entire RF range, and opposite successive effects on RSA_FC indexes: from RF of 0.15 to 0.42 Hz, VT variations enhances them and from 0.42-0.5 Hz, VT changes reduces them. Thus, the use of our instantaneous RSA spectral measures clarifies the functional explanation of the effects produced by the continuously increasing-decreasing VT maneuver on the RSA mechanism time course.