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

Alejandra Guillén-Mandujano, Salvador Carrasco-Sosa
Universidad Autónoma Metropolitana-I, CDMX, México.

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 ($_{CF}HF$, $_{P}HF$) of RR intervals ($_{CF}HF_{RR}$ and $_{P}HF_{RR}$) and respiration ($_{CF}HF_{RES}$ and $_{P}HF_{RES}$), estimated by a time-frequency distribution. We used the $_{CF}HF_{RES}$-$_{CF}HF_{RR}$ relation and their difference ($\Delta_{CF}HF$) as RSA_{FC} indexes, $_{P}HF_{RR}/_{P}HF_{RES}$ coherence (RSA_{CO}) as RSA_{PC} index, and $\sqrt{(_{P}HF_{RR}/_{P}HF_{Res})}$ 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 $\Delta_{CF}HF$ 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.