

Transfer Function Gain between Heart Period and QT Variabilities Increases during Sympathetic Activation Induced by Head-up Tilt

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The duration of the electrical activity of the heart is measured by the QT interval derived from the surface electrocardiogram as the time distance between the onset of the Q-wave and the end of the T-wave. The QT variability in the low frequency band (LF, from 0.04 to 0.15 Hz) is utilized as a marker of sympathetic modulation directed to the ventricles. However, the magnitude of QT variability might be affected by HP variability as a consequence of the QT-HP relation. This work hypothesizes that the gain of the relationship between heart period (HP) and QT in the LF band as assessed via a model-based linear transfer function could be better suited than QT variability to infer the cardiac sympathetic control as a consequence of its intrinsic normalization by the magnitude of HP changes.

In this study we assessed transfer function gain (TFG) via the identification of an autoregressive model with exogenous input from HP to QT as well as autoregressive spectral QT and HP markers in 23 healthy young subjects (age 26 ± 6 years, 11 males) recorded during head-up tilt with tilt table inclination at 0° (T0), 45° (T45) and 90° (T90).

QT variability in the LF band increased from 5.04 ± 9.81 during T0 ms^2 to 23.85 ± 74.54 ms^2 during T90. No significant changes were observed between T0 and T45. TFG increased from 0.04 ± 0.01 during T0 to 0.07 ± 0.09 during T45 and 0.08 ± 0.09 during T90 and the raise was significant during T45 and T90 compared to T0.

Since the TFG in the LF band could detect the increased sympathetic activation induced by head-up tilt with a magnitude of the orthostatic stimulus smaller compared to the QT variability power in LF band, we conclude that the TFG in the LF band could be a more sensitive marker of the increased sympathetic drive.