Dependence of Atrial Fibrillatory Rate Variations Induced by Head-Up/Down Tilt-Test on Autonomic Action

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Background: Autonomic nervous system (ANS) alterations have been suggested to have major influence on atrial fibrillation (AF) initiation and maintenance. Variations in ANS activity across patients could play a significant role in explaining inter-individual variability in the efficacy of anti-AF therapies. This work aimed to assess the relationship between changes in autonomic balance and in atrial fibrillatory rate (AFR) oscillations ($F_{\mathrm{f}}(t)$) induced by head-up (HUT) and head-down (HDT) tilt test.

Methods: 29 patients with persistent AF (psAF) underwent a tilt test protocol (baseline (BL), HUT and HDT) and ECGs were recorded and analyzed to extract $F_{\mathrm{f}}(t)$ and its respiratory modulation ($\Delta F_{\mathrm{f}}(t)$). Electrophysiological simulations of stable reentrant rotors in 2D human atrial psAF tissues were performed. Different combinations of parasympathetic stimulation (PSS) and sympathetic stimulation (SS) levels, simulated by varying the concentrations of acetylcholine (ACh) and isoproterenol (Iso), were tested. The respiratory-related modulation of ACh was modeled by a cyclic temporal variation of ACh.

Results: In the patients, HUT/HDT resulted in an increase/decrease in AFR with respect to BL. Variations in $\Delta F_{\mathrm{f}}(t)$ from HDT/HUT to BL/HDT were significantly positively correlated (Pearson r=0.51/r=0.50) with the variations in mean AFR (Fig.1 A)). In the simulations, higher Iso and/or mean ACh led to an increase in mean AFR, while $\Delta F_{\mathrm{f}}(t)$ was correlated to the range of ACh variation (Fig.1 B)).

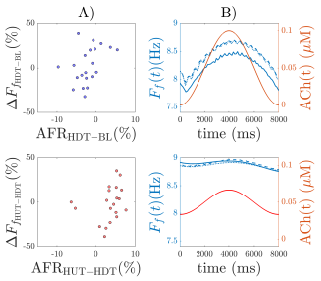

Figure 1: A) Relative changes in AFR vs $\Delta F_{\mathrm{f}}(t)$ from real ECGs. B) $F_{\mathrm{f}}(t)$ (blue) and ACh(t) (red) from simulations ((HDT vs. BL; HUT vs. HDT). Solid/dotted/dashed lines represent 0.0/10 nM/1 μM Iso.

Conclusion: HUT increased AFR, which could be explained by an increase in SS. HDT decreased AFR, possibly supported by a reduction in SS. In both cases, the concomitant variation in $\Delta F_{\mathrm{f}}(t)$ could be associated with changes in PSS.