Tilt-Induced Changes in RR Series Characteristics: An AV Node Simulation Study

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Aims: The autonomic nervous system (ANS) can initialize and maintain but also terminate atrial fibrillation (AF). In the ECG recordings during tilt test, changes in AF rate as well as the RR series characteristics can be observed. We aim to investigate to what extent these changes can be explained by ANS induced changes in the atrial input and in the atrioventricular (AV) nodal characteristics.

Methods: Average RR series characteristics (mean, rmssd and sample entropy) and average atrial fibrillatory rate (AFR) for supine, head-down and head-up tilt from 24 patients were obtained. The dual-pathway physiology of the AV node was modelled as a series of interacting nodes; each with a refractory period (R) and conduction delay (D) dependent on the stimulation history and scaled to account for ANS induced changes. The series of inter-arrival times of atrial impulses entering the AV node (AA series) were modelled using a Pearson Type IV distribution, with the mean and std obtained from the AFR.

Results: The results (Fig. 1) indicate that changes in the AA series alone do not explain the observed changes in the RR series characteristics. For example, replicating the decrease in RR mean and RR rmssd from supine to head-up required a decrease in R by 4% and in D by 15%.

Conclusion: The model replicates changes in RR mean and RR rmssd, but not RR sample entropy, during tilt test. Inclusion of short-term variations in the AV-parameters might improve the results for RR sample entropy, and set an interesting direction for further model improvements.

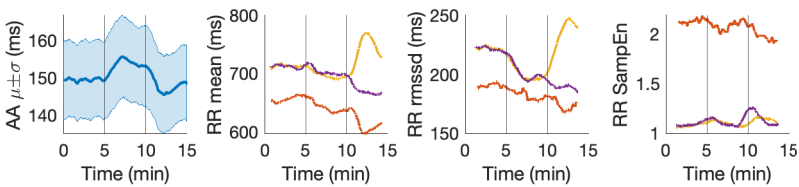

Figure 1. (Blue) AA series. (Red) Average of clinical RR series characteristics. Average of simulated RR series characteristics with fixed R and D (Yellow) and with scaled R and D during tilt (Purple).