Quantifying the Autonomic Nervous System influence on Heart Rate Turbulence using Partial Least Squares Path Modeling

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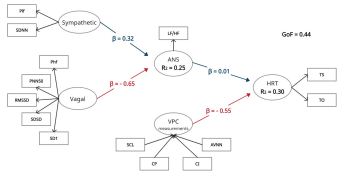
Background: Heart rate turbulence (HRT) is a physiological phenomenon used for cardiac risk stratification. Its alteration or absence indicates a significantly increased likelihood of mortality. It is accepted the baroreflex hypothesis and overall autonomic nervous system (ANS) tone as a source of the HRT. However, the influence of the ANS on HRT needs to be further investigated.

Objective: Our aim was to propose a cause-effect relationship model to quantify the influence of the ANS, assessed by HRV indices, on HRT.

Methods: 481 holter recordings from different pathologies, namely acute myocardial infarction (AMI), coronary artery disease (CAD) and end-stage renal disease (ESRD) (from The telemetric and Holter ECG Warehouse) were used. We proposed to model the relationship between HRT and ANS as a cause-effect relationship model based on Partial Least Squares Path Modeling (PLS-PM), a method for structural equation modeling that allows analyzing the relationships between the observed data and the latent variables. HRT parameters were estimated on individual ventricular premature complex (VPC) tachograms. HRV indices (time and frequency domain) were computed from 3-min before VPC tachograms. The data set was split into: low-risk and high-risk patients according to HRT parameters turbulence slope and onset (TS, TO). We propose to model HRT as a function of latent variables accounting for sympathetic and parasympathetic activity.



PLS-PM model for low-risk ESRD patients.

Results: SDNN, LF, TS and TO were the most relevant variables. In low-risk patients, ANS activity was negatively related to HRT. Whereas correlation between coupling interval and HRT on high-risk depends on the pathology.

Conclusions: PLS-PM suggests that the influence of physiological variables on HRT is broken on high-risk and differs from low-risk. Results of the model are in agreement with the baroreflex hypothesis.