

Joint Order Pattern Analysis to Assess Baroreflex Coupling of SBP and PI Series in Rats

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INTRODUCTION: Insight in complex heart rate (HR) and blood pressure (BP) interactions reveals important aspects of baroreceptor reflex (BRR) control of short-term BP fluctuations. The symbolic method of order pattern analysis is enhanced to represent BP and pulse interval (PI) joint dynamics within four consecutive heart beats. The synchronization between source, SBP (systolic) series and target, PI series was assessed using probability density function (pdf) of permutations /transcriptions/ which map SBP changes into PI responses. The deviation of transcription pdf from uniform pdf was measured by Kullback-Leibler divergence (KLD).

EXPERIMENT: The BRR loop was opened at different levels using pharmacological blockade of β -adrenergic (by prazosine), α -adrenergic (by metoprolol) and M-cholinergic (by atropine) receptors. Experiments were done in conscious telemetred Wistar out bred male rats.

METHOD: The stationary time series of SBP and PI of length 1024 were preprocessed to remove respiration induced variability. The symbolization procedure is shown in Fig.1. The symbol associated with four consecutive samples is vector of their rank-ordered indices, yielding 4! different patterns. The permutations mapping SBP into PI symbolic words were analyzed and the presence of higher order permutations was evaluated reflecting dissimilarity between the source and target symbols. KLD was calculated for different time-delays between SBP and PI series, in order to evaluate the time-delay from change in SBP to BRR mediated PI response.

RESULTS: The pdf of transcription changes clearly reveals the increase of higher order transcriptions in open BRR loop (Fig.2), revealing more dissimilarity and random like behavior. KL divergence in control protocol reached maxima 0.22 for delay of 3, 4 and 5 beats between SBP and PI. KLD gradually decreases in opened BRR loop to 0.05 due to β -adrenergic blockade and 0.02 due to α -adrenergic and M-cholinergic blockade. Besides, KLD dependence on time delay was lost in open BRR loop.

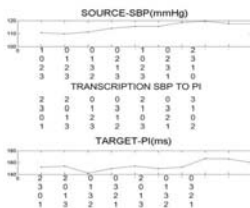


Fig.1

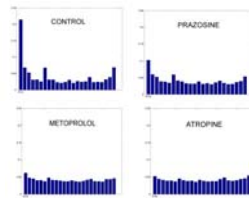


Fig.2