EVALUATION OF HEART RATE VARIABILITY USING RECURRENCE ANALYSIS

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INTRODUCTION

There is an increasing importance of nonlinear analysis of biological data in the last few years. We can describe selected processes generated in living organism much more effectively using specific methods of nonlinear analysis. Recurrence analysis - the subject of this study - is one of these techniques.

GOAL

The main goal of our study was to verify the possibilities of recurrence analysis in neuroscience.

METHODS

Recurrence plots - the basic instrument of recurrence analysis allow visualization of phase space trajectories using two-dimensional graph. During recurrence analysis the pair test is computed. For N states, we compute N^2 tests. If the distance between the two states i and j in trajectory less than the threshold ϵ, the value of the element in the recurrence matrix R is one, otherwise this value will be zero [1, 2].

RP can be mathematically expressed as

\[ R_{i,j} = \Theta(\epsilon, \| x_i - x_j \|) \]

\[ x_i \in R^n, \quad i, j = 1...N, \]

where \( N \) is the number of considered states \( x_i \), \( \epsilon \) is a threshold distance, \( \| \cdot \| \) is a norm, \( \Theta(\cdot, \cdot) \) is the Heaviside function.

The structures created in RP represent the basis for so-called recurrence quantification analysis (RQA). It is a set of parameters introduced by Zbilut and Webber [2] for the possibility of quantitative evaluations of RP.

RESULTS

We found significantly higher percentage of recurrent points from RQA measurement in patient with CMT and FPV compared with control group. RQA measurement based on diagonal lines showed significantly higher percentage of points forming diagonal lines (the value of DET parameter - determinism), in group with CRPS and PRE-COLL compared on the control group.

CONCLUSION

We have verified the possibility of using recurrence analysis for the evaluation of heart rate variability. The RQA parameters can be used together with commonly used parameters of HRV to evaluate the heart rate variability in neuroscience. The main RQA parameters suitable for the evaluation of HRV are recurrence rate (RR), determinism (DET), entropy (ENTR) and longest vertical line (LAMV).

REFERENCES
