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CAPABILITIES OF AN INFORMATION-ANALYTICAL SYSTEM FOR ASSESSING MOTOR ACTIVITY IN PARKINSON'S DISEASE DURING SLEEP

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ABSTRACT — The research aimed to study motor activity in Parkinson's disease during sleep using a data analytical system developed by authors. The study included 8 patients (4 men and 4 women) diagnosed with Parkinson's disease at the age from 59 to 89 years. All patients were clinically evaluated for motor deficit (UPDRS Part III), motor fluctuations (UPDRS Part IV), functional activity (UPDRS Part I), non-motor symptoms (UPDRS Part II) and the clinical global impression. Using our information-analytical system we obtained data on motor activity during sleep and processed it on the following parameters: number of movements, maximum value of the jerk and motor activity coefficient. For the number of movements, the average value for men was 56.7, for women — 47.2. For the maximum value of the jerk, the average value for men was 22.1 g/s, for women — 16.7 g/s. For motor activity coefficient, the average value for men was 27.7%, for women — 22.3%. Thus, the feasibility of using the information analytical system for assessment of motor activity in Parkinson's disease during sleep and the necessity of studying hypokinetic tremors during sleep has been shown.

KEYWORDS — Motor activity during sleep, Parkinson's disease, hyperkinesis, information analytical system.

INTRODUCTION

According to the World Health Organization (WHO), there is a high rate of nervous system diseases in the world. The world prognosis for Parkinson's disease is also unfavorable — the morbidity has increased among the population, thus, in Russia, from 2010 to 2017 it increased by 5.9% [1].

To diagnose, monitor the course and determine the prognosis of Parkinson's disease, neurologists around the world use the Movement Disorder Society unified Parkinson's disease rating scale (MDS-UPDRS). MDS-UPDS is quite well established in clinical neurology; however, there is still a significant demand in the practice of outpatient neurologists and doctors of related specialties for instrumental methods of diagnosing Parkinson's disease and various forms of tremors. The development of innovative and affordable diagnostic systems for Parkinson's disease and multiple forms of hyperkinetic tremors will help clinicians to perform early verification and a reliable prognosis in the so far incurable diseases.

Long-term monitoring of Parkinson's disease and its evaluation with the use of new information parameters has still remained on a poor level. Research into motor activity in Parkinson's disease using the information analytical system (IAS) has been insufficient [2, 3]. Upon review of existing research, the number of movements, the jerk value and motor activity coefficient were not considered and investigated as information parameters.

Purpose of the study is to study motor activity in Parkinson's disease during sleep using the proposed information analytical system.

MATERIAL AND RESEARCH METHODS

The study was conducted on 8 patients (4 men and 4 women) diagnosed with Parkinson's disease at the age from 59 to 89 years. All subjects gave informed consent for participation in the study. All patients were clinically evaluated for motor deficit (UPDRS Part III), motor fluctuations (UPDRS Part IV), functional activity (UPDRS Part I), non-motor symptoms (UPDRS Part II), clinical global impression. The study was conducted during the night sleep period: with the activation of the information analytical system (IAS) from the moment of going to bed with subsequent falling asleep until the moment of waking with the IAS turned off [4, 5]. The IAS device was fixed on the wrist of the hand of the sub-dominant hemisphere (for right-handed persons — on the left hand, for left-handed persons — on the right hand). The duration of a single study was 8 hours. For each subject, motor activity registration using IAS was conducted over three consecutive nights. At the end of the procedure, information about the subject's motor activity was stored in the memory of the IAS device. The obtained data was processed and presented for further analysis of the following parameters using special software:

1 — Number of movements — the highest number of hand movements out of the total number of movements on each axis during the whole study (dimensionless quantity);

2 — Jerk — the maximum value of the acceleration change rate modules during data recording (g/s);

3 — Motor activity coefficient (MAC) — the ratio of the number of files with significant motor activity to the total number of files (%).

RESEARCH RESULTS AND THEIR DISCUSSION

As a result of the research, the following data was obtained. For the number of movements, the average value for men was 56.7; for women — 47.2; maximum values for men — from 10 to 113, for women — from 30 to 70. For the jerk, the average value for men was 22.1 g/s, for women — 16.7 g/s; the maximum values for men were from 10 to 59 g/s, for women — from 9 to 26 g/s. For motor activity coefficient, the average value for men was 27.7%, for women — 22.3%; maximum values for men — from 8.4 to 41.7%, for women — from 11.8 to 34.8%.

The data show relatively large average values of the analyzed parameters of the number of movements, maximum jerk value and motor activity coefficient in men compared to women.

Fig. 1 shows motor activity indicators in the form of a histogram in a selected study subject.

Fig. 2 shows motor activity graphs in the three axes in a selected study subject.

Due to the analysis of the study of patients with Parkinson's disease using the number of movements, the jerk value and the motor activity coefficient as information parameters, it was demonstrated that it is possible not only to diagnose, but also to correct treatment with the help of our information analytical system for assessing motor activity in Parkinson's disease during sleep.

The revealed parametric information with a difference between the male and female genders can indicate sexual dimorphism during Parkinson's disease and requires further research and comprehensive analysis.

It is also possible to have multiple diagnostics available at outpatient conditions and clarification of clinical features of the course of different nosological entities of hyperkinesis during sleep.

The obtained results, primarily, have practical value with scientific novelty and originality in the form of application of innovative methods of registration of motor activity during sleep with the following analysis for diagnostics, treatment and prognosis of diseases of extrapyramidal system.

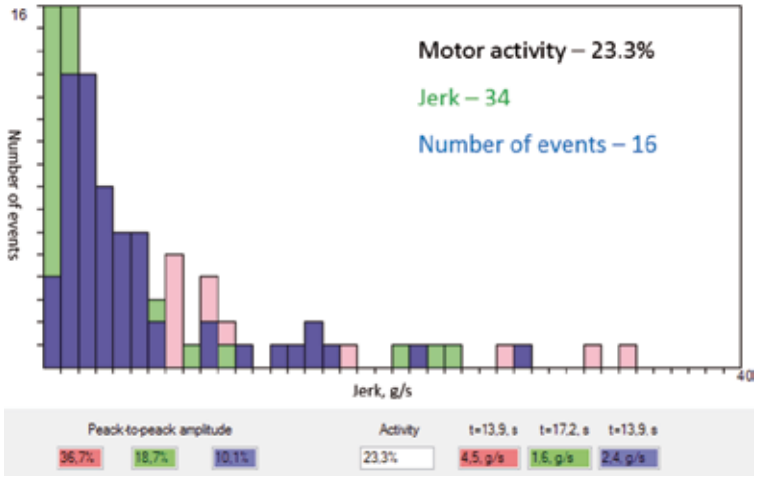

Fig. 1. *Night-time motor activity histogram in Parkinson's disease*

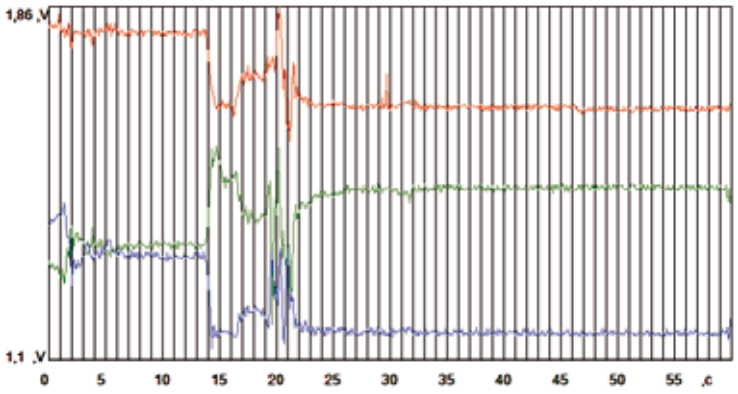

Fig. 2. *Graphs of motor activity on three axes at night in Parkinson's disease*

CONCLUSION

The feasibility of our findings should be extrapolated on further researches of motor activity during sleep using the proposed information-analytical system.

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