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NOSOLOGICAL SPECIFICITY OF MOTOR ACTIVITY IN THE PSYCHIATRIC CLINIC DURING NIGHT SLEEP

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ABSTRACT — While continuing the cycle of studies on the human motor activity during sleep, we examined 12 male patients with schizophrenia, mental retardation and other mental disorders caused by damage and dysfunction of the brain or somatic illness. Data on motor activity during sleep were obtained using an information-analytical system with registration of the number of movements, the maximum magnitude of jerk and the coefficient of motor activity. The nosological specificity of motor activity during sleep at night in patients with schizophrenia, mental retardation and other mental disorders caused by damage and dysfunction of the brain or somatic illness was revealed.

KEYWORDS — physical activity during sleep, information-analytical system, other mental disorders due to damage and dysfunction of the brain or somatic illness, schizophrenia, mental retardation.

INTRODUCTION

According to the WHO, the prevalence of mental illness in the world is currently about 160 people per 1000 population. 5 out of 10 most serious diseases of all known worldwide are mental [1].

Schizophrenia is widely associated with significant disability, can affect learning and working activity, and limit quality of life. It can also be a severe mental disorder affecting more than 20 million people worldwide. Patients with schizophrenia are 2–3 times more likely to die earlier than the general population [2].

In addition to clinically significant features and complications caused by mental illness, its consequences for social and everyday life are of great importance for the patient. Mental retardation is characterized by developmental impairment, including the cognitive functions and adaptive behavior. Lack of mental development prevents from coping with everyday household tasks [3].

One of the most difficult problems in modern medical science is the cumulative dynamic analysis of a physiological and/or pathological condition. Among kinematic systems using various algorithms for processing, analysis and interpretation of signals of motor activity, accelerometry is a quite promising one. Although there are a large number of studies of sleep using accelerometry, there have been no studies of motor activity for mental disorders using accelerometry [4].

MATERIALS AND METHODS

We examined 12 patients (12 men) at the Tambov Psychiatric Clinical Hospital aged 20 to 32 years with the following diagnoses according to the international classification of diseases (ICD-10): F06 (Other mental disorders caused by damage and dysfunction of the brain or physical illness), F20 (Schizophrenia) and F70 (Mild mental retardation) [5]. Before the study, all subjects gave informed consent to participate in the study.

The study was carried out during the period of night sleep: the information and analytical system (IAS) was on from the moment of going to bed, followed by falling asleep until the moment of awakening when the IAS was switched off. A detailed research methodology was described in our previous works (a study of young healthy people and a study of patients with Parkinson's disease) [6, 7].

To solve the problem of measuring and recording motor activity, we have developed an IAS with a primary measuring transducer based on a 3-D accelerometer and recording the measured values of motor activity on a memory card with their subsequent interpretation using specialized software [8]. Later, using specially developed software [9], the obtained data were processed and presented for further analysis of the following parameters (Fig. 1, 2):

1 — number of movements — the maximum number of hand movements along each axis for the entire study period (dimensionless value);

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

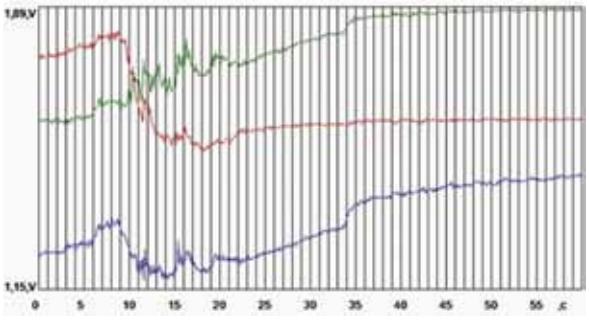

Fig. 1. Graphs of motor activity along three axes

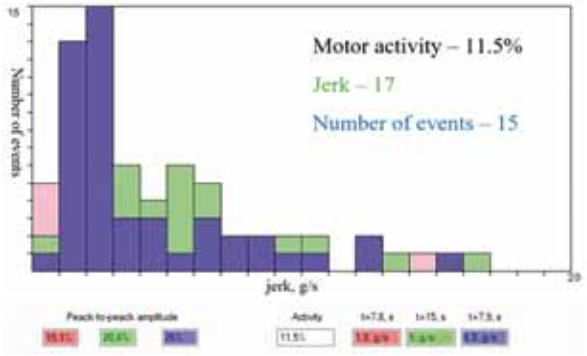

Fig. 2. Histogram of motor activity at night with mental retardation

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

RESULTS AND DISCUSSION

As a result of the study, the following data were obtained.

In the group of patients with other mental disorders due to brain damage and dysfunction or somatic illness, the average value for the number of movements was 15.5; maximum value — 25; the minimum value - 6. The average value of the maximum jerk magnitude was 25 g/s; the maximum value was 32 g/s; the minimum value was 13 g/s. For the coefficient of motor activity, the average value was 31.7%; the maximum value was 37.9%; the minimum value was 9.8%.

In the group of patients with schizophrenia, the mean for the number of movements was 17.7; the maximum value was 27; the minimum value was 7. The average value of the maximum jerk magnitude 23.5 g/s; the maximum value was 31 g/s the minimum value was 13 g/s. For the coefficient of motor activity, the average value was 15.1%; the maximum value was 26.5%; the minimum value was 12.4%.

In the group of patients with mild mental retardation the average value of the number of movements was 9.9; the maximum value was 14; the minimum value was 6. The average value of the maximum jerk magnitude was 22.8 g/s; the maximum value was 28 g/s; the minimum value was 13 g/s. The average value of the coefficient of motor activity was 6.9%; the maximum value was 13.2%; the minimum value was 5.8% (Fig. 1, 2).

Patients diagnosed with F70 show relatively low rates compared to other patient groups. The F20 group is characterized by a noticeable difference in terms of the maximum jerk magnitude and the coefficient of motor activity. In the F06 group, the indicators are slightly higher than in the F70 group, and at the same time, the variance in this group is lower than in the rest. All this indicates a difference in the nature of motor activity in patients with various disorders. At the same time, this division is not final and is rather for informational purposes for a specialist doctor.

When compared with the results of healthy people [6], there are noticeable differences in patients with different diagnoses in terms of the parameters of the coefficient of motor activity and the number of movements. These differences will be discussed in detail in one of the following articles.

CONCLUSION

The findings suggest a search for further system upgrades to improve diagnostics and treatment. This will lead to the minimization of technical and technological means, as well as the amount of time spent for the survey, and, consequently, an increase in the accuracy of information and, then, an increase in the quality of future research.

REFERENCES

1. GBD 2015 Neurological Disorders Collaborator Group. Global, regional, and national burden of neurological disorders during 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Neurol. 2017;16(11):877-897. doi: https://doi.org/10.1016/S1474-4422(17)30299-5
2. **Laursen TM, Nordentoft M, Mortensen PB.** Excess early mortality in schizophrenia. Annu Rev Clin Psychol. 2014;10:425-48. doi: 10.1146/annurev-clinpsy-032813-153657
3. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). – Arlington, VA: «American Psychiatric Publishing», 2013. 992 p. – ISBN 978-0-89042-554-1. — ISBN 978-0-89042-555-8. – ISBN 0-89042-554-X.
4. **Julius S. Bendat and Allan G. Piersol.** Random Data: Analysis and Measurement Procedures.

John Wiley & Sons, 2011, p. 640. ISBN1118210824, 9781118210826.

5. International Classification of Diseases, Tenth Revision (ICD-10). 2015. (Date of the application: 17.12. 2021. https://www.cdc.gov/nchs/icd/icd10.htm).
6. **Gorbunov A., Gromov Yu., Parshin D., Egorov V., Dolgov E., Grechukha D.** Characteristics of human motor activity during sleep in young adults (18–21 years) using information-analytical system. Archiv EuroMedica. 2021;11(1):87–89. http://dx.doi.org/10.35630/2199-885X/2021/11/1.20
7. **Gorbunov A., Parshin D., Gromov Yu., Neprokin A., Dolgov E., Grechukha D.** Capabilities of an information-analytical system for assessing motor activity in Parkinson's disease during sleep Archiv EuroMedica. 2021;11(1):84–86. http://dx.doi.org/10.35630/2199-885X/2021/11/1.19
8. **Gorbunov A.V., Egorov S.A., Egorov A.S.** Device for recording human motor activity // Patent of the Russian Federation No. 168584 dated 09.02.2017 (In Russ.).
9. **Gorbunov A.V., Egorov S.A., Egorov A.S.** A method for diagnosing epilepsy and a device for its implementation // Patent of the Russian Federation No. 2640138 dated 26.12.2017 (In Russ.).