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CLINICAL AND GENETIC DIAGNOSTICS OF PARKINSONISM: ANALYSIS BEFORE AND AFTER BRAIN NEUROSTIMULATION

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Abstract: In recent decades, deep brain stimulation, especially of the subthalamic nucleus (STN), has become an effective treatment method for patients with Parkinson's disease (PD) who do not respond to medication therapy. The aim of this study is to analyze the clinical dynamics and genetic aspects in patients with parkinsonism before and after brain neurostimulation.

Key words: Parkinson's disease, neurostimulation, deep brain stimulation (DBS), genetic markers, DBS efficacy.

Introduction. Parkinson's disease is characterized by progressive loss of dopaminergic neurons, leading to motor and non-motor disorders. Neurostimulation of deep brain structures, such as STN, GPI, and VIM, has shown significant improvement in motor functions in patients with PD.

Parkinsonism represents a complex neurological syndrome characterized by cardinal motor manifestations including bradykinesia, rigidity, tremor, and postural instability. While Parkinson's disease (PD) constitutes the most prevalent etiology, accounting for approximately 80% of cases, the clinical spectrum encompasses multiple disorders including atypical parkinsonian syndromes, secondary parkinsonism, and hereditary neurodegenerative conditions with parkinsonian features. This heterogeneity presents significant diagnostic challenges, particularly in early disease stages when phenotypic overlap is most pronounced.

The last two decades have witnessed paradigm-shifting advances in understanding the genetic architecture of parkinsonism. The identification of monogenic forms (PARK loci) and numerous risk variants through genome-wide association studies has revolutionized our conceptualization of disease pathogenesis. These genetic discoveries have not only elucidated novel molecular pathways—prominently including α-synuclein proteostasis, mitochondrial dysfunction, and lysosomal-autophagy system impairment—but have also begun informing clinical practice through improved diagnostic precision and emerging stratification approaches for therapeutic interventions.

Deep brain neurostimulation (DBS), particularly targeting the subthalamic nucleus or globus pallidus interna, has established itself as a transformative intervention for medication-refractory motor fluctuations and dyskinesias in PD. Contemporary studies demonstrate that carefully selected patients experience substantial improvement in motor function, quality of life, and reduced medication requirements following DBS implementation. However, the relationship between specific genetic variants and DBS outcomes remains incompletely characterized, representing a critical knowledge gap in the era of precision medicine.

The interface between genetic profiles and neurostimulation response presents compelling questions regarding patient selection criteria, optimization of stimulation parameters, and long-term management strategies. Emerging evidence suggests that certain genetic subgroups—notably those with GBA or LRRK2 mutations—may exhibit distinctive responses to DBS intervention, potentially necessitating tailored approaches to both pre-surgical planning and post-operative management. Additionally, longitudinal assessment of clinical phenotypes before and after neurostimulation provides a unique opportunity to dissect the complex interplay between genetic factors, disease progression, and therapeutic responsiveness.

This research aims to comprehensively evaluate the clinical and genetic characteristics of parkinsonian patients before DBS implementation and analyze how these parameters correlate with post-neurostimulation outcomes. By integrating advanced genetic diagnostics with detailed pre- and post-operative clinical assessments, we seek to identify predictive biomarkers of DBS response, refine patient selection algorithms, and contribute to the development of personalized therapeutic strategies for this heterogeneous patient population. Furthermore, this investigation addresses the critical need for evidence-based guidelines regarding the interpretation and clinical application of genetic information in the context of neurostimulation interventions for movement disorders.

Materials and methods. The study included 56 patients with late-stage PD (38 men, 18 women), mean age 63.2 ± 7.5 years, who were indicated for neurosurgical correction using deep brain neurostimulation. Clinical evaluations were conducted using the MDS-UPDRS scale (part III) before surgery, 2 and 6 months after intervention. Fall risk assessment was evaluated using scales: Mini-BESTest and ABC scale. Genetic analysis included the study of polymorphisms of genes associated with PD - LRRK2, SNCA, GBA polymorphisms (NGS), before and after surgery.

Results. After STN neurostimulation, significant improvement in motor functions was observed (Table 1).

Table 1. Changes in motor activity (on the MODS-UPDRS scale, part III)

Evaluation time	Average score	Standard deviation
Before DBS	52.4	±6.8
After 2 months	31.2	±5.3
After 6 months	29.8	±4.9

According to the study, STN stimulation reduced the severity of the "shutdown" period by 45-65%, reduced the severity of drug dyskinesia by 67-83%, and reduced the dose of dopaminergic drugs by an average of 50% (Table 2).

Table 2. Levodopa dose reduction after DBS

Time	The average daily dose of levodopa (mg)
Before DBS	is 1050
After 6 months	520

Assessment of the risk of falls using the Mini-BESTest scale showed that 35% of patients had a high risk of falling before surgery. After the operation, this figure dropped to 30%, and a year later it was 33%. Similar results were obtained using the ABC scale (Table 3).

Table 3. The risk of falls on the Mini-BESTest scale

Time	Percentage of high-risk patients
Before DBS	35%
After 6 months	30%
After 12 months	33%

Genetic analysis revealed certain polymorphisms associated with the response to neurostimulation. Patients with certain genotypes showed a more pronounced improvement in motor functions after surgery. However, additional studies are needed to confirm these data (Table 4).

Table 4. Genetic correlation and response to DBS

A genetic marker	Patients with the mutation	DBS efficiency (% UPDRS reduction)
GBA	12 (21.4%)	38.5%
LRRK2	7 (12.5%)	51.2%

SNCA	3 (5.4%)	43.1%
Without mutations	34 (60.7%)	48.6%

Conclusions. The results confirm the effectiveness of DBS in reducing motor symptoms, reducing the dose of medications, and moderately reducing the risk of falls. Genetic analysis showed a different degree of response depending on the mutations, especially in GBA carriers, in whom the effect was less pronounced. These data highlight the importance of genetic stratification in DBS planning. STN neurostimulation is an effective treatment method for PD patients who do not respond to drug therapy. Our data confirm the results of previous studies, demonstrating an improvement in motor function and a reduction in the dose of medications after surgery.

Neurostimulation of deep brain structures, especially STN, is a promising method of treating Parkinsonism. Clinical improvements after surgery confirm the effectiveness of this approach. Genetic research opens up new horizons for individualization, personalization of treatment and improvement of its effectiveness, however, additional research is needed to introduce them into clinical practice.

List of literature:

1. Barseghyan, A. G., & Yakovlev, A.V. (2016). Parkinson's disease and neurosurgical treatment methods. Moscow: Medical Book.
2. Voskresenskaya, E. M. (2018). Neurology: clinic and diagnosis. St. Petersburg: Peter.
3. Golubeva, L. M., & Prokopenko, A. A. (2017). Genetics of neurodegenerative diseases: Parkinson's disease and Alzheimer's disease. Moscow: MEDpress-inform.
4. Ivanova, M. N. (2015). Neurostimulation in the treatment of movement disorders in Parkinson's disease. St. Petersburg: Special Literature.
5. Kovalenko, A. P., & Smirnov, V. I. (2020). Genetics and molecular diagnostics of Parkinson's disease: current issues and practical aspects. Tashkent: National Medical Academy.
6. Mazur, A.V. (2014). Neurosurgical treatment of movement disorders in patients with Parkinson's disease. Moscow: Neurosurgery.
7. Petrov, Yu. A. (2019). Genetic aspects of Parkinson's disease: from the molecule to the clinic. Moscow: Expert.
8. Rykov, V. V., & Sidorov, S. G. (2016). Neurostimulation in Parkinson's disease: clinical studies and practical recommendations. Kazan: Kazan University.
9. Sidorov, A.V. (2015). Diagnosis and treatment of Parkinson's disease in Russia: approaches and technologies. Novosibirsk: SibSMU.
10. Fedorova, N. S., & Smirnova, V. I. (2017). Modern methods of diagnosis and therapy of Parkinson's disease. Moscow: RMSU.
11. Hafizov, R. G., & Alieva, Z. I. (2018). Genetic markers and neurostimulation in Parkinson's disease. Tashkent: Uzbek Medical Journal.
12. Shatilova, A.V., & Schultz, A. A. (2019). Molecular genetic studies in the diagnosis of Parkinson's disease. Kazan: Medicine and Education.
13. Shcherbina, I. A. (2018). Methods of diagnosis and treatment of neurodegenerative diseases. Moscow: GEOTAR-Media.
14. Shahabiddinova, N. S. (2020). Genetic testing in the treatment of Parkinson's disease in Uzbekistan. Tashkent: Uzbek State Medical University.
15. Yakovlev, V. A. (2016). Neurogenetics and neurorehabilitation in diseases of the nervous system. St. Petersburg: BHV Publishing House-Petersburg.

16. Deutschl, G., Scheid-Brittinger, S., Krak, P., and others (2006). A randomized study of deep brain stimulation in Parkinson's disease. New England Journal of Medicine, 355(9), 896-908. DOI: 10.1056/NEJMoa060281

17. Chariz M. I., Krak P. And Cuba S. (2010). Long-term results of deep brain stimulation in Parkinson's disease. In the book by J. L. McClelland and P. T. Marsh, Handbook of Parkinson's Disease (ed.). CRC Press/Taylor and Francis.

18. Vidailet, M., Verquel, L., and Ueto, J. L. (2007). Molecular genetics of Parkinson's disease and deep brain stimulation: implications for treatment. Neurobiology of Diseases, 26(3), 648-654. DOI:10.1016/j.nbd.2007.07.010

19. Getz, K. G., and Olanov, K. U. (2009). Parkinson's disease: diagnosis and clinical treatment. 2nd ed. Elsevier Health Sciences.

20. Klingelhofer, L., and Reichmann, H. (2015). Parkinson's disease and the environment. In the book of X. Reichmann "Parkinson's disease: clinical treatment" (ed.). Jumper.

21. Kiburts K., McDermott M. (2016). Genetic factors in Parkinson's disease. In J. C. Bartels & W. Schulte-Merker (eds.) "Genetics in Neurology: Application in clinical practice". Jumper.

22. Tan, E. K., & Chao, Y. H. (2018). Genetic mutations in Parkinson's disease: a review of the role of LRRK2, GBA, and SNCA. Current Reports on Neurology and Neurobiology, 18(8), 49. DOI: 10.1007/s11910-018-0859- x

23. Vitjas T., Krak P. (2005). Deep brain stimulation in Parkinson's disease: a new challenge in controlling motor fluctuations. Parkinsonism and Related Disorders, 11(6), 367-373. DOI:10.1016/j.parkreldis.2005.06.002

24. Reichman, H. (2018). Clinical diagnosis of Parkinson's disease: a review. In the book "Parkinson's Disease: Clinical management", Springer.

25. Shapira, A. H., & Olanov, K. U. (2014). Parkinson's disease: pathogenesis and clinical treatment. Elsevier.

26. Zaitsev V. S., Ivankina E. I. (2020). The role of genetic factors in the development of Parkinson's disease: Clinical aspects and genetic diagnosis. Journal of Neurology and Psychiatry, 12(2), 24-31.

27. Cormier-Decker F., Tison F. (2017). The effectiveness of deep brain stimulation in Parkinson's disease and its effect on cognitive and psychiatric symptoms. Motor Disorders, 32(5), 722-734. DOI:10.1002/mds.26967

28. Olanov, K. U., & Obso, J. A. (2014). Pathophysiology and treatment of Parkinson's disease. Oxford University Press.

29. Quinn, N. (2017). Parkinson's disease: clinical aspects and therapy. Oxford University Press.

30. National Institute of Neurological Disorders and Stroke (NINDS). (2020). A page with information about Parkinson's disease. Taken from https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

31. Marti, M. J., and Tolosa, E. (2007). Parkinson's disease and other movement disorders. In S. J. Kurlan's book "Practical Neurology: diagnosis and Treatment" (ed.). Elzevir.