**Gozhenko A. I., Sluchenko O. N. Autoimmune and metabolic structural changes in the brain of patients with multiple sclerosis. Journal of Education, Health and Sport. 2025;77:75195. eISSN 2391-8306. https://dx.doi.org/10.12775/JEHS.2025.77.75195**
**https://apcz.umk.pl/JEHS/article/view/75195**
**https://zenodo.org/records/21886064**

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences);
Health Sciences (Field of medical and health sciences). Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).© The Authors 2024;
This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 21.12.2024. Revised: 27.12.2024. Accepted: 05.01.2025. Published: 30.01.2025.

# AUTOIMMUNE AND METABOLIC STRUCTURAL CHANGES IN THE BRAIN OF PATIENTS WITH MULTIPLE SCLEROSIS

**A. I. Gozhenko, O. N. Sluchenko**

**Ukrainian Research Institute of Transport Medicine, Odessa, Ukraine**

## Abstract

Using data from a comprehensive examination of 64 patients diagnosed with multiple sclerosis based on clinical and neurological examination, the authors examined the relationship between structural changes in the brain, the uric acid cycle, and the intensity of the autoimmune process. It was found that structural changes in the brain are not associated with age or gender differences but are always accompanied by reduced uric acid levels and the presence of myelin-associated glycoprotein. The authors indicate that the value of the latter two parameters correlates with the duration of the process. The authors believe that changes in uric acid cycle activity contribute to the development of an autoimmune process that causes structural brain damage. The authors believe that the increase in biochemical and autoimmune disturbances over the course of the disease contributes to the persistence of brain damage and offsets compensatory changes in the brain.

**Key words: multiple sclerosis; uric acid; structural brain damage.**

Multiple sclerosis (MS) is a demyelinating, chronic, progressive disorder of the central nervous system, common among young adults (20-40 years). The prevalence of MS has remained

relatively stable—1-2 million patients worldwide—over the past several decades. Characteristic for the development of this disease is almost 100% disability of patients with multiple sclerosis, and high mortality among them [1, 2].

The main focus of treatment measures is currently concentrated on reducing the severity of the process, preventing relapses, and prolonging remissions [2, 4].

The limited scope of tasks facing physicians treating these patients is due to the complexity and insufficient understanding of the pathogenesis of MS. Current understanding of multiple sclerosis as a result of autoimmune and inflammatory changes in the brain and spinal cord [5, 7, 8] does not demonstrate the sources of autoantibodies and the mechanisms of involvement of humoral and hormonal regulatory systems in the pathogenesis of this disease. At the same time, according to literature data [4, 6, 8], the destructive action of superoxide radicals causes the formation of autometabolites with antigenic action. A complex antioxidant system of enzymatic and non-enzymatic mechanisms controls the activity of superoxide radical formation. and thus regulates the development of autoimmune processes [8]. However, in the available literature we have not found data on the state of antioxidant mechanisms, in particular the uric acid cycle, in patients with multiple sclerosis.

Based on the above, the aim of our work was to assess the state of the uric acid cycle in patients with MS, and correct it with the activity of autoimmune processes and structural changes in the brain.

**Materials and methods.** The material for this work was obtained from the study of 64 patients. The data obtained from the examination of 12 practically healthy individuals without neurological pathology served as a control. The group of MS patients consisted of 41 women and 11 men. By age, they were ranked into 3 subgroups: 22-30 years old - 18 patients; 31-44 years old - 30 patients; over 45 years old - 3 patients. The duration of the verified disease correlated with the age of the patients: for individuals in the age subgroup of 22-30 years - up to 5 years; 31-44 years old - up to 15 years, 45 years and older - more than 15 years.

All sick were observed V neurological department Road Clinical Hospital of the State Enterprise "Dnieper Railway" station Dnepropetrovsk. The diagnosis of multiple sclerosis was based on a combination of subjective and objective examination data, including MRI and a clinical and neurological assessment. Additionally, a 5 ml blood sample was drawn from patients upon admission to the clinic, and the serum was separated and analyzed for uric acid and myelin-associated glycoprotein levels. Uric acid levels were determined according to the phosphotungsten method. Uric acid reduces the phosphotungsten reagent to form a blue complex. colors. Intensity

coloring proportional content in sample uric acid; the content of myelin-associated glycoprotein was determined by prescriptions for enzyme immunoassay methods for detecting antibodies to MAG.

MRI examination to assess structural changes in the brain was performed on tomographs with a magnetic field strength of 0.35-1.5 Tesla. T2-weighted images in Flair mode were used, which ensured high sensitivity, but some smaller specificity. For temporal characteristics hearth T1-weighted imaging with contrast was used. All MRI data processing was performed using uniform criteria. The number and size of foci of destruction, their location, and developmental stages were determined, with detailed indication of the brain structures in which these foci were located. The nature of changes in the subarachnoid spaces was determined by the maximum width of the interhemispheric fissure and the Sylvian fissures; the number of other fissures in the cerebral hemispheres was also counted. To characterize the ventricular system, the indices and widths of the lateral ventricles, as well as the third and fourth ventricles, were determined.

The obtained results were subjected to standard and statistical processing and summarized in a table.

**Results and discussion.** Clinical neurological studies revealed that all patients included in the study complained of decreased visual acuity, discomfort in the arms, legs, and facial areas (numbness, dysesthesia), impaired motor coordination, limb weakness, and pelvic dysfunction. An objective neurological examination revealed increased periosteal reflexes; increased muscle fatigue during exercise; truncal ataxia; intention tremor; and impaired extremity sensitivity.

Magnetic resonance imaging revealed the presence of foci of hyperintensity in 98.5% of those examined. No difference was found between men and women (98.8% in men, 98.3% in women). The localization of foci of hyperintensity was also the same in men and women. Most often, the foci were localized in the cerebral hemispheres (84.8% of women and 86.6% of men) and in the medulla (73.6% of women, 75.6% of men). In other parts of the brain, these foci were determined less frequently: in the brainstem - 43.2% of women, 42.7% of men; cerebellum 41% And 40.2% respectively, V spinal brain — 39.3 % women; 37.8% in men.

It should be noted that in the vast majority of patients, lesions were localized in two or more brain structures. Approximately one-third of male and female patients (33.7-34.1%) had lesions and diffuse areas of hyperintensity on magnetic resonance imaging. According to MRI data, there were signs of atrophy of brain structures. Signs of atrophy of the cerebral hemispheres include dilation of the ventricles and widening of the subarachnoid spaces. occurred in more than 80% of those examined. Atrophic changes in the cerebellum were significantly less common,

occurring in 1/6 of cases. Overall, the degree of brain structure changes in MS patients is independent of their age and gender.

At the same time, biochemical and immunological studies revealed significant changes in myelin-associated glycoprotein (MAG) and uric acid levels in patients with MS. The study results are presented in Table 1.

As Table 1 shows, individuals without neurological symptoms typically lack myelin-associated glycoprotein (MAG). In patients with multiple sclerosis, MAG is detected at a highly diluted level, indicating high levels of this autoantigen in their blood. It should be noted that the degree of MAG dilution decreases with increasing disease duration.

Table 1

Contents uric acids And myelin-associated glycoprotein at sick RS

With different duration diseases.

| Group of patients | Myelin-associated glycoprotein | | Urinary acid | |
|---|---|---|---|---|
| | control | Sick RS | Control | Sick RS |
| 22-30 | deny | 1: 240 | 280 ± 0.06 | 157.6 ± 0.05 |
| 31- 44 | 0 | 1:180 | 280 ± 0.06 | 164.0 ± 0.045 |
| 45 and older | 0 | 1:160 | 280 ± 0.06 | 148.5 ± 0.07 |

This may be due to the transition of the pathological process to a chronic state or an age-related decline in the immune system's reactivity. At the same time, these patients have significantly lower than normal plasma uric acid levels. Furthermore, the absence of significant fluctuations in uric acid levels in patients with varying durations of the pathological process is noteworthy. This latter circumstance suggests that changes in uric acid metabolism are not a consequence of the development of the pathological process, but rather an independent phenomenon.

Thus, the results of our research showed that the deployment of clinical paintings RS is happening on background reduced contents uric acid, which does not change with the duration of the pathological process, i.e., the identified phenomenon is a background of MS. Since, according to P. V. Zolotukhin et al. (2014), uric acid is part of the antioxidant circuit, its deficiency can cause an increased destructive effect of superoxide radicals. However, in this case, unusual polypeptides can accumulate in the body and become autoantigens. The presence of autoantigens provokes the formation of autoantibodies and the development of an autoimmune

conflict. The formation of autoantigens is evidenced by the accumulation of myelin-associated glycoprotein in the examined patients. However, this assumption makes the uric acid metabolism cycle a possible pathogenetic mechanism of MS. Further research in this area is needed to move from a proposal to certainty.

**References**

1. Vinnichuk CM. Absent-minded sclerosis / CM. Vinnichuk, O.A. Malovitskaya. — Kyiv: Kompolis, 2001. — 56 p.

2. Gusev E.I. Multiple sclerosis and other demyelinating diseases / E.I. Gusev, I.A. Zavalishin, A.N. Boyko. - Miklosh Publishing House, 2004. - 526 p.

3. Davydovskaya M.V. Neurodegenerative process in multiple sclerosis and possible ways of its correction / M.V. Davydovskaya, A.N. Boyko, E.I. Gusev // Journal of Neurology and Psychiatry named after S.S. Korsakov. - 2009. - Vol. 109, No. 7 . - P. 44 - 52.

4. Evtushenko S.K. Modern criteria for early diagnosis of reliable multiple sclerosis / S.K. Evtushenko, I.N. Derevyanko // International Neurological Journal. - 2005. - No. 1. - P. 70 - 85.

5. Zavalishin I. A. Multiple sclerosis: modern aspects of etiology and pathogenesis / I. A. Zavalishin, M. N. Zakharova // Journal of Neurology and Psychiatry named after S. S. Korsakov. - 2003. - No. 2. - P. 10 - 17.

6. Zolotukhin P.V. Positive contour of uric acid, homocysteine, NOX, XOR: nephrological aspects / P.V. Zolotukhin, V.K. Chmykhalo, M.S., Makarenko, S.A. Corinthian, Yu.A. Lebedeva, HE. Kuzminova, A.A. Belanova, L.V. Gutnikova, A.A. Aleksandrova // Nephrology. - 2014. - Vol. 18, No. 5. - P. 16 - 21.

7. Levchenko I.L. Features of the immune status in men and women with relapsing multiple sclerosis / I.L. Levchenko, T.V. Negreba // Ukrainian Bulletin of Psychoneurology. - 2010. - Vol. 18, issue. 2 (63). - P. 20 - 23.

8. Favorova O.O. Genetic predisposition to multiple sclerosis as a polygenic autoimmune disease / O.O. Farforova, A.V. Farforov, A.N. Boyko et al. / S.S. Korsakov Journal of Neurology and Psychiatry. - 2009. - Vol. 109, No. 7. - P. 16 - 22.