

## **AUTONOMIC NERVOUS SYSTEM RESPONSE IN PATIENTS WITH THE CONSEQUENCES OF A CLOSED BRAIN INJURY TO "MAGNETIC STORMS"**

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### **Abstract**

The authors, based on the results of examining the state of subjective and objective clinical indicators of the ANS activity in 49 patients with the consequences of mild closed craniocerebral trauma, before, during, and after the "magnetic storm" assessed the features of the ANS activity. The research results showed that a magnetic storm causes a sharp increase in the frequency of subjective and objective manifestations of impaired activity of the ANS, which led to the expansion and aggravation of the symptom complex on the day of the magnetic storm. The next day, the frequency of subjective and objective neurological disorders decreases and the general condition of patients improves. Indicators of the state of the autonomic nervous system also react to a magnetic storm. The essence of the reaction is to increase the frequency of excessive or insufficient autonomic reactivity and autonomic support of activity.

All human studies were conducted in compliance with the rules of the Helsinki Declaration of the World Medical Association "Ethical principles of medical research with human participation as an object of study". Informed consent was obtained from all participants.

**Keywords:** *autonomic nervous system, magnetic storm*

## Introduction

In the process of evolution, living systems used natural electromagnetic fields of the external environment as a source of information, providing direct adaptation of organisms to changes in external factors of the environment - coordination of the course of life processes and spontaneous changes in regulatory influences. The Sun is a powerful source of electromagnetic fields that regulate the interaction of structural elements of living systems at all levels of their hierarchical organization. Moments of spontaneous changes in the parameters of the solar electromagnetic field are today defined as "electromagnetic storms" [1].

The study of the influence of changes in the parameters of the electromagnetic field on the vital signs of such a complex biological system as the human body showed that daily changes in diastolic pressure, the number of leukocytes in the blood coincide with changes in the intensity of natural (natural) electromagnetic fields. The study of changes in the pulse rate and changes in the parameters of the electromagnetic field revealed their positive correlation. Moreover, it was shown that the implementation of this dependence is carried out with the participation of the sympathetic and parasympathetic divisions of the ANS [2-5].

One of the widespread neurological sufferings, in the formation of the characteristics of the severity of clinical manifestations, an essential role is played by the state of the sympathetic and parasympathetic parts of the ANS are the long-term consequences of closed mild traumatic brain injury [6, 7]. It should be noted that when communicating with such patients, most of them note a deterioration in their condition and the appearance of a number of autonomic disorders when the weather changes, and sometimes for no apparent reason.

At the same time, in the available literature, we found scattered and scanty data on the influence of the state of natural electromagnetic fields on the clinical objective manifestations of the activity of the ANS departments.

Based on the foregoing, the aim of the work was to assess the effect of magnetic storms on the state of the autonomic system in patients with long-term consequences of mild closed craniocerebral trauma.

## Methods

The materials of the study were the results of studies obtained during the examination of 49 patients with long-term consequences of mild closed craniocerebral trauma. Among the surveyed 38 men and 11 women. The age of the patients ranged from 27 to 45 years. The duration of traumatic brain injury in 20 patients (44.5%) is up to 5 years, in 17 patients (38%), 5-10 years in 8 patients (17.5%) more than 10 years. During the time after the injury, the patients repeatedly received therapeutic courses of recovery in a hospital setting. The study was carried out during the period of their next recovery course. Patients were examined upon admission to the hospital. It included: a subjective assessment of the patient's condition, determination of the main objective clinical signs of CNS damage; functional state of the ANS (Hilderbrant coefficient, autonomic reactivity, vegetative support of activity); a rheoencephalographic study was carried out. According to forecasters, the date of the magnetic storm was set and on the eve of this date, on the day of the magnetic storm and on the next day after the magnetic storm, patients were examined according to the above algorithm. The data obtained were subjected to statistical processing using the Student's coefficient and summarized in the table.

## Results

The patients' subjective assessment of their condition was carried out on the basis of the analysis of the frequency of occurrence of the main complaints. The results of this study are shown in Table 1.

According to the data in Table 1, the day before the magnetic storm, there was no difference in the frequency of the main complaints in the examined patients in comparison with the data obtained upon admission. At the same time, on the day of a magnetic storm, when the power of the electromagnetic field and its other parameters change, the frequency of complaints is reliably changed. Complaints of headache become more frequent by 22.2%; 5% more often patients complain of dizziness, more often by 7% patients note nausea and unsteadiness when walking, as well as

drowsiness. The frequency of other complaints, if it increases, is at the level of the trend.

Completion of magnetic storms is accompanied by a significantly better subjective assessment of their condition by the examined patients. According to the data in Table 1, the frequency of the assessed complaints can be reliably reduced. Perhaps this is due to the fact that short-term exposure to an electromagnetic field with altered parameters restores (temporarily) the normal interaction of the functional systems of the brain.

Objective neurological examination revealed changes in the frequency of manifestation of signs of CNS damage under the influence of a magnetic storm in patients with long-term consequences of LBMT. The results of this survey are shown in Table 2.

According to the data in Table 2, on the day of MS, a small part of patients develop anisocoria, which was not diagnosed either before or after the magnetic storm. The frequency of the rest in violation increased on the day of the magnetic storm; especially often decreased vision, increased frequency of convergence disorders, facial asymmetry, impaired sensitivity, autonomic disorders. On the day after the magnetic storms, the frequency of the assessed indicators decreased, and for a number of them, normalization is noted. Of particular note is a very weak decrease in the frequency of autonomic disorders, that is, we can talk about the implementation of the influence of exogenous electromagnetic fields through the structures of the autonomic nervous system.

For a more detailed study of the participation of the autonomic nervous system in the body's response to changes in the external electromagnetic field, we evaluated the changes in autonomic parameters in patients with long-term consequences of HLBI. The results of these studies are shown in Table 3.

According to table 3, the Hildebrandt coefficient, which characterizes the functional activity of the autonomic nervous system. In most of the subjects, it corresponded to the norm; on the day of the magnetic storm and on the day after it, there were no changes in the distribution of patients according to the variant of this indicator.

Vegetative reactivity on admission to the department in 2/3 patients was perverted. This

situation persisted on the eve of magnetic storms. However, on the day of the magnetic storm and the next day, the percentage of patients with normal reactivity increased sharply and the number of patients with perverted reactivity decreased by 2 times. On the day of the magnetic storm, no patients with excessive reactivity were identified, and the number of patients with insufficient reactivity increased sharply. It can be assumed that a significant change in the parameters of the external electromagnetic field on the eve and at the moment of a magnetic storm has a significant effect on the functional activity of the ANS and on the synchronization of the activity of the suprasegmental structures that make up it.

Vegetative support of VOD activity according to the data in Table 3 in the majority of patients on admission was normal, and in less part it was excessive. On the eve of a magnetic storm, the ongoing changes in the parameters of the electromagnetic field provide a sharp increase in the proportion of patients with excessive VOD and a decrease in the proportion of patients with normal VOD. This situation persisted on the day of the magnetic storm and on the day following it. It can be assumed that the restructuring of the parameters of the electromagnetic field sharply activates the activity of the suprasegmental structures of the ANS, possibly this contributes to the subsequent depletion of their functional capabilities, as evidenced by the increase in the proportion of subjects with insufficient VOD per day after the magnetic storm.

## Conclusions

Thus, the results of our research have shown that on the day of a magnetic storm, objective and subjective disorders of the central nervous system are manifested in a greater number of patients with long-term consequences of closed craniocerebral trauma. Since subjective complaints are present in a patient in the form of a complex, the result of an increase in the frequency of presentation of each of the complaints or clinical symptom in each individual patient forms a more detailed symptom complex. On the day after the end of the magnetic storm, the frequency of subjective and objective manifestations of impaired activity of the ANS returns to the initial level, in part, the symptoms are

manifested with less frequency. It can be assumed that a powerful restructuring of the parameters of the background electromagnetic field of the Earth causes changes in the activity of individual structures of the ANS, and also affects the synchronization of their activities. This possibility is confirmed by the change in vegetative parameters in the examined patients. At the same time, attention was drawn to the increase in the frequency of insufficient and excessive autonomic reactivity and autonomic support of activity. Changes in these indicators are possibly associated with the depletion of the potential of some suprasegmental structures of the ANS under the influence of a powerful change in the parameters of the Earth's electromagnetic field.

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The authors declare that there are no conflicts of interest.

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**Table 1.** The frequency of occurrence of subjective manifestations of the long-term CHMT in %

Index	Timing	Upon enrolment	One day before MS	On MS day	The day after MS
Headache		72 +/- 4	72 +/- 4	88 +/- 3 p < 0.001	69 +/- 4 p < 0.001
Dizziness		84 +/- 4	84 +/- 4	88 +/- 3 p < 0.001	62 +/- 5 p < 0.001
Nausea		57 +/- 5	56 +/- 5	61 +/- 5 p < 0.001	49 +/- 5
Noise in the head and ears		34 +/- 5	33 +/- 6	37 +/- 2 p < 0.001	31 +/- 3
Unsteadiness of gait		57 +/- 3	57 +/- 5	61 +/- 3	49 +/- 5
Fast fatiguability		84 +/- 4	84 +/- 4	89 +/- 3	81 +/- 4
Drowsiness		85 +/- 4	85 +/- 4	91 +/- 3	82 +/- 4
Sleep disturbance		84 +/- 4	85 +/- 4	85 +/- 4	72 +/- 4

**Table 2.** Changes in the frequency of the main objective clinical signs of CNS damage in patients with long-term sequelae of MCCI under the influence of MB (%)

Index	Groups	Upon enrolment	The day before MS	On MS day	The day after MS
Anisocoria		-	-	4	-
Nystagmus		20	20	24	20
Decreased vision		10	10	20	7
Breaking conversion		50	50	63	55
Decreased corneal reflexes		35	35	37	33
Facial asymmetry		67	63	80	69
Language deviation		33	33	40	30
Oral Automatism Reflexes		7	7	10	9
Anisoreflexia		50	50	60	62
Changes in abdominal reflexes		37	37	33	35
Sensory impairment		50	50	70	64
Ataxia		55	53	60	65
Tremor of eyelids, fingers		45	53	63	55
Other pathological signs		10	10	10	10
Vegetative disorders		70	70	90	83
Vegeto-visceral paroxysms		15	15	33	30

**Table 3.** Dynamics of the main autonomic parameters in patients with AMLDLChMT with a change in the parameters of the external electromagnetic field (%)

Index	Group	Upon enrolment	The day before MS	On MS day	The day after MS
Hildebrandt coefficient	Norm	80	90	87	87
	Mismatch	20	10	13	13
Vegetative reactivity	Norm	20	10	44	47
	Insufficient	7	10	20	17
	Excessive	7	10	-	13
	Perverted	66	74	37	33
Vegetative support activities of	Norm	73	57	56	50
	Insufficient	7	3	3	13
	Excessive	20	40	41	37