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CORRECTION OF AUTONOMIC NERVOUS SYSTEM INDICATORS DUE TO THE EFFECT OF GEOMAGNETIC PERTURBATIONS IN PATIENTS WITH REMOTE AFTER EFFECTS OF CLOSED TRAUMATIC BRAIN INJURY

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Abstract

The authors show that in modern biology, life is seen as the ability of living matter, and namely in medicine – the ability of human body, to maintain the existence in natural environment. From this perspective, it is extremely necessary to synchronize the activity of body structures among themselves taking into account the changes of environmental factors. Achieving the harmony between the body activity and environmental changes is carried out using an external pacemaker of life processes' activity, the role of which is performed by the geomagnetic field (GMF). This became possible due to the fact that the life processes are cyclical, i.e. they possess rhythmic characteristics, and GMF is an electromagnetic field which is changing its characteristics rhythmically.

The material for the present study were the data obtained during the neurological examination of 20 healthy people and 100 patients with remote consequences of CTBI which were treated in the clinic of autonomic nervous system pathology of the SI "Institute of neurology, psychiatry and narcology of the NAMS of Ukraine".

The results investigations have showed that geomagnetic perturbations, which modify the GMF parameters, exacerbate the disorders of VNS in patients with remote after effects of CTBI. It is associated with the increased desynchronization of the activity of suprasegmental structures of VNS and with breach of brain vascular system's status that occurs during a magnetic storm. The acupuncture that is aimed at restoring of synchronization of activity of suprasegmental structures of VNS significantly reduces its sensitivity to the geomagnetic disturbances.

Keywords: magnetic storm, closed head injury, autonomic nervous system.

In modern biology, life is seen as the ability of living matter, and namely in medicine – the ability of human body, to maintain the existence in natural environment [2]. From this perspective, it is extremely necessary to synchronize the activity of body structures among themselves taking into account the changes of environmental factors. Achieving the harmony between the body activity and environmental changes is carried out using an external pacemaker of life processes' activity, the role of which is performed by the geomagnetic field (GMF) [5, 6]. This became possible due to the fact that the life processes are cyclical, i.e. they possess rhythmic characteristics, and GMF is an electromagnetic field which is changing its characteristics rhythmically. In turn, GMF is exposed to the external "space" perturbations that affect its parameters. One of them is the effect of the electromagnetic field of the Sun in the form of "magnetic storms". The distortions of GMF parameters, arising from this, should influence the course of vital processes both in healthy and sick organisms. However, in the available literature, we have not met the data about the influence of GMF parameters' changes on the pathogenesis and course of the most widespread pathological processes.

Closed craniocerebral trauma is considered to be one of the most common pathologies of central nervous system.

Annually 5-7 thousand of traumatic brain injuries per 1 million of population are registered worldwide (according to the WHO data), among them the mild closed traumatic brain injuries (MCTBI) are the prevalent (85-90 %) [1, 2, 3]. In Ukraine the annual frequency of MCTBI makes up from 2 to 6 cases per 1 thousand of population in different regions [4].

The increase of MCTBI number is accompanied by the growth of neurological complications from these injuries.

According to the perceptions of pathogenesis of CTBI, adopted for today, the neurological complications lead to the formation of persistent dysfunction of nonspecific brain structures, and to the long-term post-traumatic impairment of neuroregulatory systems' activity (disregulation pathology), that, in interaction with psychological reaction, causes the formation of symptoms of neurological, psycho-vegetative and cognitive disorders, which flow with frequent exacerbations and decompensation periods in 30-40% of patients [6, 5].

Disregulation pathology, combined with the neuroplasticity, leads to the formation of pathological functional systems of the brain [6, 7]. Impairment of structural-functional organization of brain structures directly related to CTBI, combined with the appearance of unusual functional systems of CNS leads to the disruption of afferentation in central nervous system and creates the debilitating burden on the regulatory centers of the CNS, and this, in turn, exacerbates autonomic changes, i.e. a "vicious cycle" is forming, that changes the reaction of CNS divisions into the unusual parameters of the external pacemakers (particularly GMF). In order to overcome the "vicious circle" there must be an additional impact from the outside, which normalizes the flow of afferent impulses and thus helps to restore the reactions on changing the parameters of vital processes' external pacemaker. Acupuncture is considered to be one of such impacts.

Based on the above, the aim of this work was to prove the possibility of normalization of CNS reactions on the geomagnetic disturbances in patients with after effects of closed craniocerebral injury, using a method of acupuncture.

Materials and research methods

The material for the present study were the data obtained during the neurological examination of 20 healthy people and 100 patients with remote consequences of CTBI which were treated in the clinic of autonomic nervous system pathology of the SI "Institute of neurology, psychiatry and narcology of the NAMS of Ukraine". The age of patients ranged from 21 to 45 years. Among patients women accounted for 34 %. The age of CTBI in the vast majority of the surveyed was 3-5 years. The disease course in these patients was quite severe, as for 1-2 times a year they underwent the in-patient treatment due to decompensation of their neurological status.

A course of acupuncture consisted of 15 sessions being conducted every other day. For exposure we used the biologically active points of a head (E_8; T_{20}); occipito-cervical zone (VB_{20}; VB_{21}; V_{15}; V_{10}); abdominal points (J_{14}; J_{15}); points on the upper extremities (GI_4;

GI_{11}; MC_6; C_7; TR_5); points on the lower extremities (E_{36}; E_{44}; F_1; F_2) as well as a point RP_6. Duration of each session does not exceed 30 minutes.

Results and discussion

At admission and during the follow-up examinations patients with CTBI have passed a complex examination. The first stage of the study was the identifying of the self-assessment of patients' status. The results of the study are reflected in a table 1.

Table 1

The dynamics of degree of incidence of subjective symptoms of the disorder in patients with CTBI in terms of MS in the treatment with acupuncture (n=100)

Group / Index	on admission	before treatment			after treatment		
		a day before MS	on the date of MS	a day after MS	a day before MS	on the date of MS	a day after MS
Headache	53	72	88	69	33	46	30
Dizziness	67	84	88	62	23	23	23
Nausea	40	57	60	49	16	16	13
Noise in ears and head	25	34	37	31	26	30	26
Shaky walk	38	57	61	49	24	20	14
Rapid fatigability	54	84	89	81	16	16	16
Sleepiness	60	85	91	82	26	33	24
Sleep disorders	58	84	85	72	20	24	16

According to table 1 data, the most common complaints on admission were: dizziness, somnolence, fatigue, headache, and impaired sleep structure. These violations were noted by more than a half of examined patients. Somewhat less, but still more than a quarter of the patients complained of nausea, unsteadiness of gait, buzzing in the ears and head.

On the eve of magnetic storm the prevalence of revealed complaints had increased sharply. If the first group of complaints was noted in more than a half of the patients, but on the eve of the MB they took place in more than 5/6 of patients. The second group of complaints was already noted in more than a half of the surveyed. At the peak of the MS it was maintained the prevalence of complaints, and for fatigue, sleepiness, headache it even increased – almost all patients have presented them. The day after MS, when the parameters of geomagnetic field returned to normal, the prevalence of disorders remained at the level of the previous day, which is significantly higher than their prevalence at admission, i.e. there is some retardation of reactions to the change of parameters of exogenous pacemaker. After the course of acupuncture the surveyed patients almost did not show any complaints. However, on the eve of MS, about 1/3 of the surveyed noted the violations listed in table 1, while

headache and drowsiness were most often noted. The same situation was maintained at the peak of MS. In a day after MS, the presence of abnormalities in the activity of central nervous system was recorded by the part of patients however the number of these patients was even smaller than on the day before MS, especially this applies to headache, drowsiness, and unsteadiness of gait. It can be assumed that acupuncture improves response of the CNS to the change of parameters of life processes' exogenous pacemaker, but full normalization does not occur because of the presence of deeper changes in the structural and functional organization of suprasegmental structures of CNS.

On the next stage of the research we evaluated the CNS activity as a substrate of complaints that were presented by patients. The results of the research are reflected in a table 2.

As it follows from the data in a table 2, among the examined patients at admission there were dominated the persons with sympathicotonia, distorted vegetative reactivity, normal vegetative provisioning.

On the eve of MS the indicators of CNS activity showed the increasing of sympathetic system's activity, and increasing the number of patients with excessive vegetative provisioning. On the day of MS and one day after the end of it the situation with the activity of VNS has not changed, moreover the changing of the studied parameters indicated about the activation of VNS sympathetic division in a larger number of patients. It can be assumed that the geomagnetic influence activates exactly this division of the CNS that causes the rigidity of adaptation processes in the CNS.

A course of acupuncture had radically changed the situation. We observed no growth in the number of patients with activation of sympathetic system either yesterday or on the date of MS, or on the day after the MS. Moreover, throughout the observation period there were dominated the persons with normal vegetative provisioning among the examined patients.

Table 2

The dynamics of CNS status indexes in patients with CTBI in terms of MS under influence of acupuncture (n=100)

Group / Index		on admis-sion	before treatment			after treatment		
			a day before MS	on the date of MS	a day after MS	a day before MS	on the date of MS	a day after MS
Kerdo vegetative index	Eutonia	7	-	7	-	30	23	33
	Sympathico-tonia	59	70	69	80	43	49	36
	Parasympathi-cotonia	34	30	24	20	27	28	31
Minute blood volume	Eutonia	30	10	-	-	40	33	46
	Sympathico-tonia	43	60	81	89	43	43	30
	Parasympathi-cotonia	27	30	19	11	17	24	24
Hildebra ndt coefficie nt	Normal	79	90	100	86	92	79	92
	Unbalance	21	10	-	14	8	21	8
Vegetative reactivity	Normal	20	-	43	7	59	49	63
	Insufficient	7	10	20	46	-	7	20
	Excessive	7	-	-	13	-	-	7
	Distorted	66	90	37	33	41	44	10
Vegetati ve provision ing	Normal	73	40	43	49	79	70	87
	Insufficient	7	-	-	14	-	-	3
	Excessive	20	60	57	37	21	30	10

Since the activity of CNS determines the state of functional activity of vascular system, which, in turn, carries out the oxygen-substrate provisioning of brain activity, we evaluated the status of the given system according to the changes of REG parameters. The results of the research are reflected in a table 3.

As can be seen from the table 3, on the eve of geomagnetic storm the value of all REG parameters is increasing. At the peak of the magnetic storm we can observe their further increasing. After passing the magnetic storm the studied parameters are weakening doubtfully, in the order of tendency. It can be assumed that the functional activity of suprasegmental divisions of the CNS (the divisions governing the activity of vessels) is very sensitive to the changes of external pacemakers' parameters. However tehe return of geomagnetic field' parameters to their normal values after the

magnetic storm does not lead to the rapid normalization of the status of the cerebrovascular system, i.e., there has been a marked inertia in the functional activity of the brain vascular system.

Table 3

The peculiarities of REG-indicators in patients with after effects of CTBI treated with acupuncture due to changing of geomagnetic conditions (n=100)

Lead / **Index**	Lead	on admission	**before treatment**			**after treatment**		
			a day before MS	on the date of MS		a day before MS	on the date of MS	
RI	FM	50,0	72,0	77,0	70,0	80,0	75,0	45,0
	OM	68,0	72,0	72,0	77,0	20,0	65,0	55,0
BI	FM	53,0	78,0	87,0	80,0	10,0	90,0	10,0
	OM	62,0	83,0	92,0	83,0	10,0	90,0	20,0
DI	FM	50,0	80,0	78,0	80,0	10,0	75,0	20,0
	OM	63,0	80,0	80,0	83,0	10,0	90,0	30,0
L	FM	10,0	17,0	20,0	15,0	70,0	20,0	-
	OM	15,0	22,0	22,0	18,0	10,0	25,0	-
L/T	FM	12,0	17,0	20,0	13,0	73,0	20,0	-
	OM	18,0	20,0	17,0	15,0		16,5	-

The observed changes of REG indices testify that under the influence of GMF parameters' changes the tone of cerebral arteries (both small and large) is increasing, volaemia and venous congestion are increasing too, i.e., the activity of brain's transport system is significantly deteriorating that is resulting in a deepening of brain damages associated with TBI.

A course of acupuncture has changed the reaction of REG indicators for the geomagnetic storm. As it can be seen from a table 3, on a day before the MS, the number of patients with higher rates of REG indexes was smaller (exponentially), in comparison with the data on baseline. The exception was for L and L/T indexes, which increased in a significant part of examined patients. At the peak of MS, the number of patients with increased REG indicators was corresponded to the subgroup of untreated patients. It can be assumed that the reaction of suprasegmental structures on MS in patients after acupuncture was much more short and rapid. On the other day after MS the number of patients with higher REG rates returned to the level before the beginning of the magnetic storm, i.e., adaptive and regulatory capabilities of VNS in patients with CTBI have been restored under the influence of acupuncture.

Perhaps it happens due to the restoration of synchrony and balance of activity of functional systems of suprasegmental structures of VNS.

Thus, the results of our investigations have showed that geomagnetic perturbations, which modify the GMF parameters, exacerbate the disorders of VNS in patients with remote after effects of CTBI. It is associated with the increased desynchronization of the activity of suprasegmental structures

of VNS and with breach of brain vascular system's status that occurs during a magnetic storm. The acupuncture that is aimed at restoring of synchronization of activity of suprasegmental structures of VNS significantly reduces its sensitivity to the geomagnetic disturbances.

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