

Research Of Changes Of Essential Elements Composition In The Cerebrospinal Fluid In Patients With Outcomes Of Traumatic Brain Injury Before And After Endolumbar Ozonotherapy

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Abstract: *The aim of this research is to investigate the essential elements composition in the cerebrospinal fluid of patients with various outcomes of traumatic brain injury before and after complex treatment with the use of endolumbar and intracystal introduction of ozone and pyracetam in dynamics. Thus, it may be noted positive changes in the metabolism of macro- and microelements in the cerebrospinal fluid of patients.*

Keywords: *macroelements, microelements, cerebrospinal fluid, ozone, outcomes of TBI*

1. INTRODUCTION

Traumatic brain injury (TBI) for a long time is one of the most actual and complex problem of modern neurosurgery, that many domestic and foreign authors noted in their publications [1, 2, 3, 4, 5]. This is stipulated not only by a high frequency of occurrence, the complexity of the pathogenesis, clinical manifestations and high mortality, but also by an enormous economic damage. One of the most important circumstances stipulating the actuality of the problem is the frequent victims' disability, which arises due to the development of various pathological conditions, persistent symptom complex, united under the name of the outcomes of TBI. Just their formation, in the most cases stipulated economic damage caused by cranial injuries [6, 7, 8, 9, 10, 11, 12].

Ozonated saline solution has been successfully used by intravenous introduction in patients with severe TBI in the acute period [13, 14, 15, 16]. One of the first endolumbar introductions of ozone-oxygen mixture has been carried out in 1967, by A.B. Bolgaev in patients with post-traumatic epilepsy [17]. S.D. Madyarov (1988) has been used once endolumbar introduction of ozone-oxygen mixture as the prevention of cerebral arachnoiditis in patients with severe TBI in the volume of 15 cm³ [18]. In 1994, M.K. Agzamov has been carried out scientific researchers on the application of nootropic-ozone mixture in the complex treatment of severe TBI [13]. In 2007, 25 patients with meningitis of different etiologies have been successfully

treated by V.M. Belopukhov and his colleagues with the use of endolumbal introduction of ozone-oxygen mixture in the complex treatment [15].

The beginning of the XXI century was marked not only the accumulation of fundamental knowledge in the field of neuroimmunology and neuroelementology, but also the beginning of the application of this knowledge in practice, according to the concept of metabolic protection of the brain [19, 20].

Elaborated in the recent years problem of determining the role and significance of separate chemical elements presenting in tissues and biological fluids of human organism is important both in normal condition and in a variety of diseases, in particular of the nervous system. Variations in the content of macro- and microelements, imbalance of metalloids' homeostasis caused by both food and ecological factors, as well as somatic diseases which change the status of the nervous system and form an unfavorable background not only for the beginning and development of injuries and diseases of the nervous system, but also for the restoration process. The above changes have significantly influence on the understanding of neurorehabilitation measures [21, 22, 23, 24, 25, 26, 27, 28]. The study of domestic and foreign literatures have been showed the absence of researchers devoted to the content of macro- and microelements in the cerebrospinal fluid in the outcomes of TBI [29, 30, 31, 32].

The aim of the study:

The aim of this research is to investigate the composition of macro- and microelements in the cerebrospinal fluid of patients with different outcomes of TBI before and after complex treatment with the use of endolumbar and intracystal introduction of ozone and pyracetam in dynamics.

2. MATERIALS AND METHODS

The data of 166 patients with various outcomes of TBI in age from 1 year to 60 years old (126 men and 40 women) have been included in the investigation who were hospitalized in Neurosurgical Department of Samarkand State Medical Institute from 2009 to 2019. All patients equally with clinical and neurological X-ray investigations (MRI, CT) were carried out laboratory investigations to determine the macro- and microelements (K, Na, Cl, P, Mg, Fe) in the cerebrospinal fluid with the use of "Roche-Hitachi" analyzer before and after 4-6 months treatment. Among the examined patients in 62 patients (37,3%) it has been diagnosed with post-traumatic cerebral arachnoiditis (PTCA), in 42 patients (25,3%) it has been diagnosed post-traumatic chronic subdural hematoma (PCSH), in 30 patients (18,1%) it has been diagnosed post-traumatic epilepsy (PE), in 26 patients (15,7%) it has been diagnosed post-traumatic arachnoid cyst (PTAC) and in 6 patients (3,6%) it has been diagnosed chronic vegetative status (CVS) (Figures 1, 2).

For the treatment of patients with outcomes of TBI we offered the new methods endocystal introduction of ozone and endolumbar introduction ozone with nootropics (certificates of priority № IAP 2011 0419 and 2011 0148 № IAP) [33, 34].

The method of treatment of arachnoid liquor cysts is that after the imposition of milling holes it has been made dissection and excision of the cyst walls and connection it with subarachnoid and subdural spaces and then vinyl chloride or silicone catheter has been introduced into the cystic cavity and through this catheter with the use of medical syringe it has been injected ozone in the amount of 10-30 cm³ depending on the cyst size, the catheter is left for 3-5 days for the re-introduction of ozone [34].

The next method is the way endolumbal insufflation of ozone and pyracetam in patients with different outcomes of TBI, as mentioned above. These patients under sterile conditions after

premedication and local anesthesia by the use of novocain solution 0,5% – 10,0 ml, a lumbar puncture was performed between the 3rd and 4th lumbar vertebrae, and then it has been evacuated liquor (20-40 ml depending on the liquor pressure) and endolumbal injected first ozone (10-30 cm³), and then pyracetam 2,5% – 3% from 200 mg to 1000 mg depending on the age of the patient [33].

Patients were carried out the following methods of treatment: in patients with PCSH it has been carried out mini-invasive removal of hematomas and endolumbal insufflation of ozone and pyracetam on 7-8 days after surgery; in patients with PTAC it has been carried out mini-invasive cysts emptying and endocystal introduction of ozone in the day of surgery and for 3-4 days after surgery. In PCA, PTE and in patients with CVS after severe TBI it has been conducted endolumbal insufflation ozone and 2-3% solution of pyracetam (doubly per treatment course).

Figure 1.

Forms of outcomes of TBI (MRI and CT examples)

a). Posttraumatic cystic cerebral arachnoidit. CT of patient K. Is determined by a small arachnoid cysts in the left frontal region and cystic-adhesive changes of convexital areas of the brain. b). Posttraumatic epilepsy. MRI of patient R. Determined by the seat of epilepsy - posttraumatic cystic-glial degeneration in the right frontal region of the brain. c). Posttraumatic arachnoid cyst. MRI of patient B. Is determined by a arachnoid cysts in the right temporal-basal region of the brain. d). Posttraumatic chronic subdural hematoma. MRI (axial, coronar scans) of patient A. Determined by chronic subdural hematoma in the left hemisphere of the brain. e). Chronic vegetative status. MRI of patient J. Determined by bilateral subdural hydroma fronto-temporal-parietal lobes and post-traumatic atrophic processes of the brain.

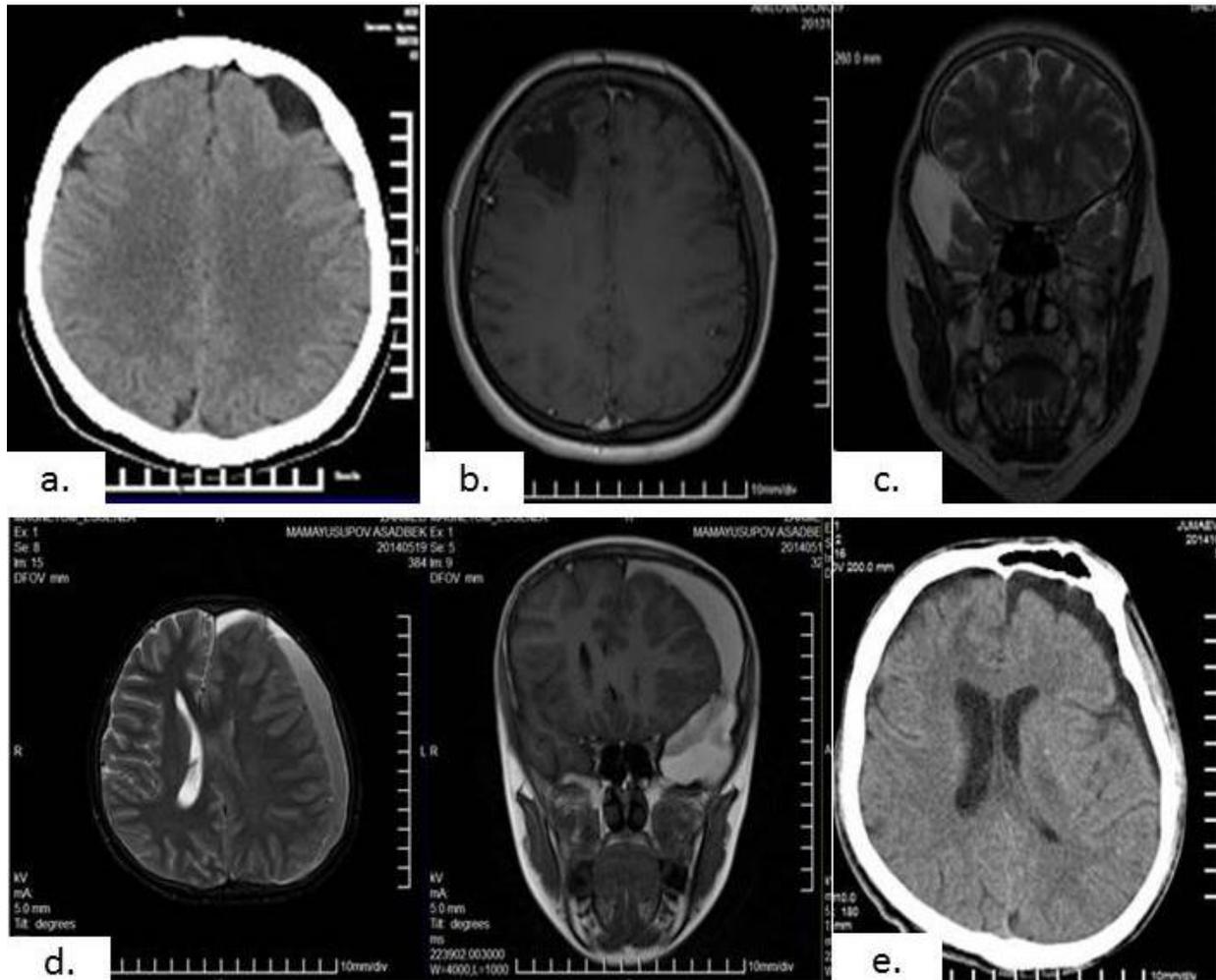
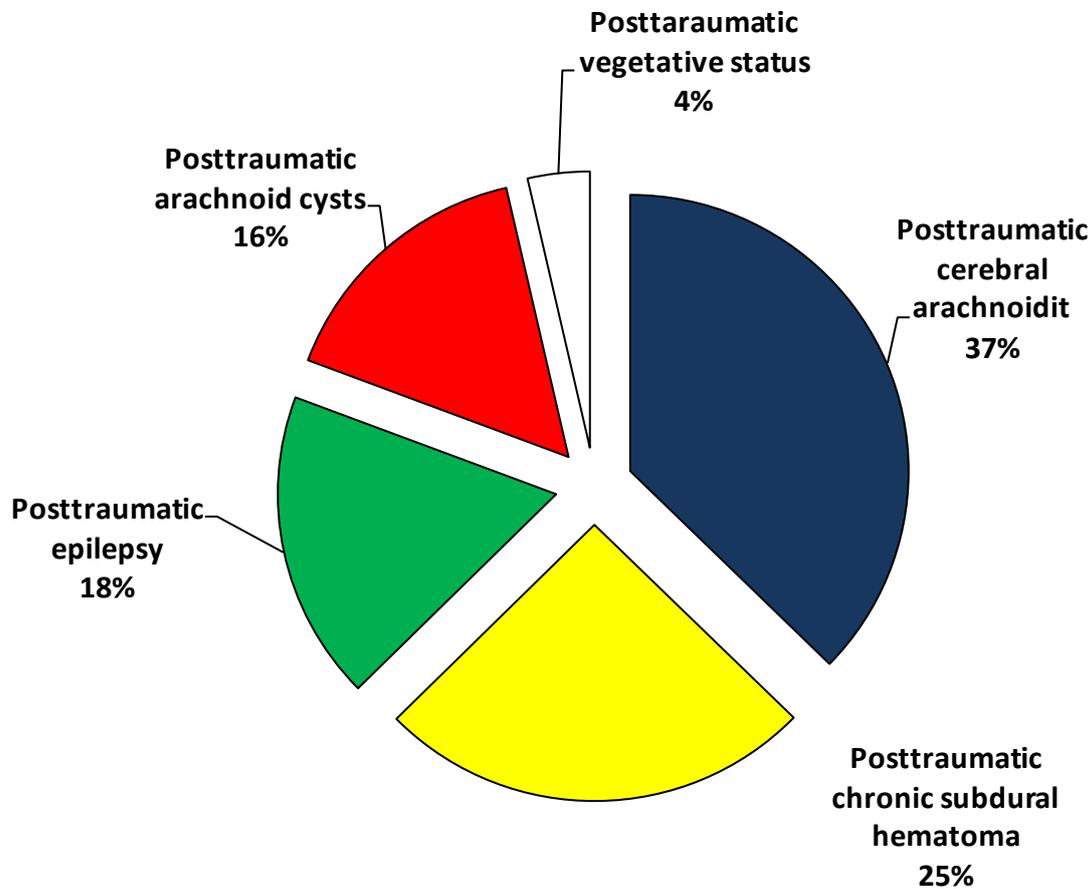


Figure 2.

Distribution of patients according to the forms of outcomes of TBI



3. RESULTS AND DISCUSSION

In order to determine the value of pathogenetic changes of macro- and microelements in the brain tissues during the outcomes of TBI after using endocystal and endolumbal introduction of ozone and pyracetam, laboratory tests including determination of chemical elements phosphorus (P), calcium (Ca), iron (Fe), magnesium (Mg), sodium (Na), potassium (K) and chlorine (Cl) in the blood serum and in liquor, which play an important role in the activities CNS were performed.

As shown in Table 1. in the cerebrospinal fluid tests of these patients it has been observed amounts Ca has been decreased in 89,2% of patients and amounts of elements such as K and Cl were low in all (100%) patients. Minimal and maximal amounts of P, Fe and Na in the liquor were normal, but the average amounts of P and Na were high (41% and 86,7% accordingly). An increased amount of Mg in the liquor has been noted in 38,6% (32) of patients in comparison with maximal indexes (Table 2.).

Thus, the quantitative changes of all macro- and microelements in the cerebro-spinal fluid in a range of research were noted and once again it has been proved the occurrence of this condition as a result of deep metabolic-biochemical deficiency in the human organism during different outcomes of TBI, it gives us the basis to introduce new pathogenically proved and effective treatment methods in the intermediate and distant periods of traumatic brain disease.

Table 1. Quantitative indexes of macro- and microelements in the CSF in patients with outcomes of TBI (before treatment)

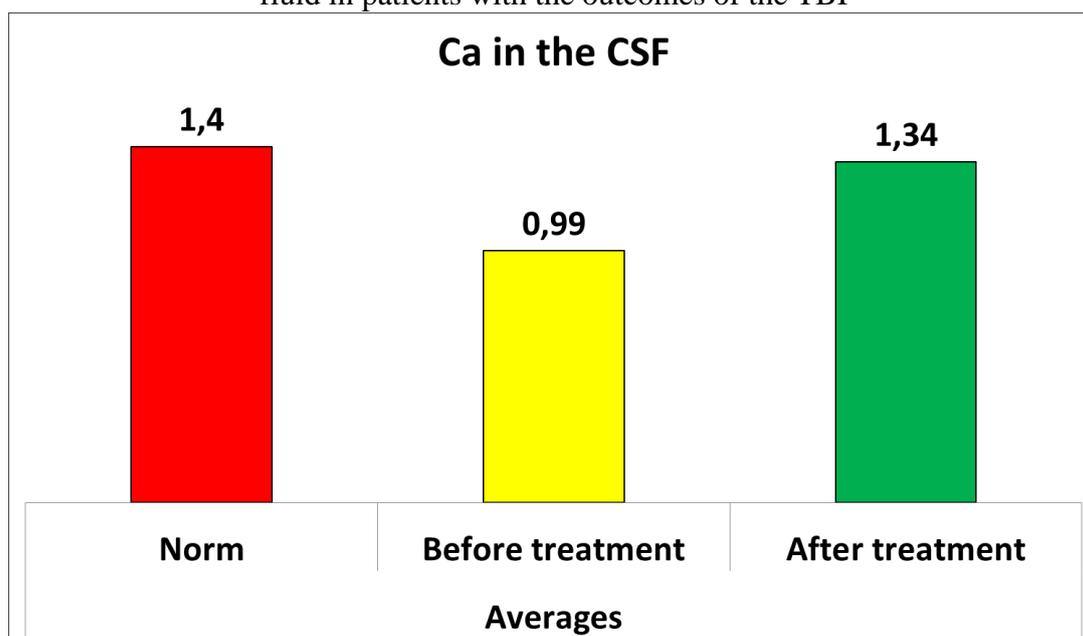
Elements	Average indexes (mmol/l)		Minimal indexes (mmol/l)		Maximal indexes (mmol/l)	
	In normal condition	Result	In normal condition	Result	In normal condition	Result
P	0,5	0,83	0,39	0,24	0,68	1,43
Ca	1,4	0,99	1,12	0,69	1,75	1,18
Fe	17	14	5,4	2,1	28,6	25,9
Mg	1,3	1,51	1,23	1,22	1,4	2,06
Na	132,5	140,2	120	121,1	145	151,9
K	3,7	2,3	3,07	2,01	4,35	2,68
Cl	204,5	149,3	197	119,5	212	192

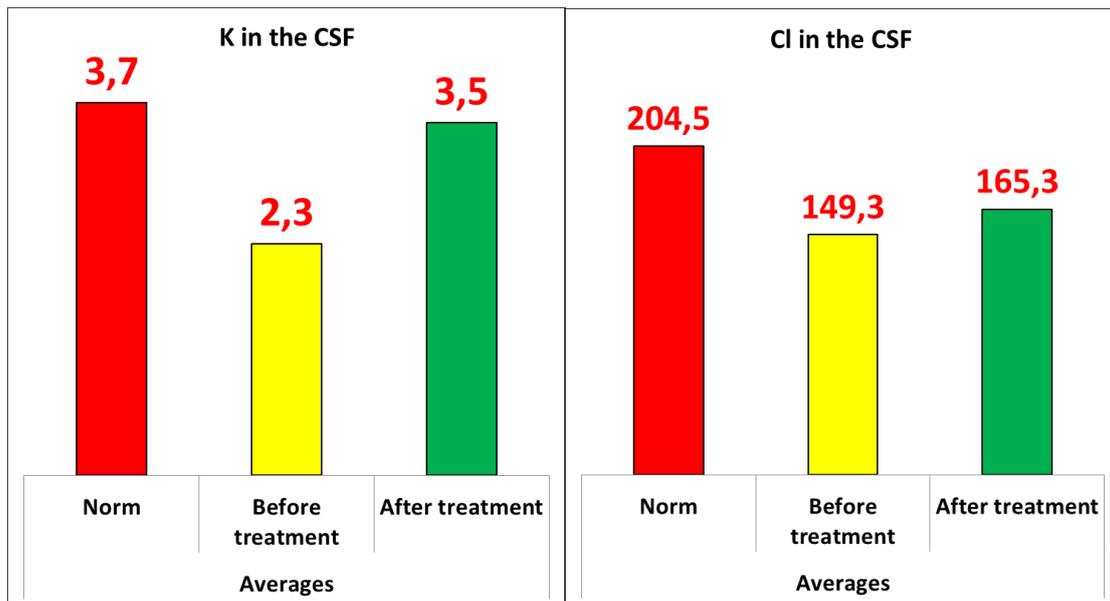
Taking into consideration the above conditions, it has been used the new method of treatment – endolumbar and endocystal insufflation of ozone and pyracetam in the intermediate and distant periods of traumatic disease of the brain and the following results were obtained. On the expiry of 3-6 months after treatment the amount of macro- and microelements in the cerebrospinal fluid were tested.

Dynamic changes of the structure of macro- and microelements in cerebrospinal fluid after treatment were in the following way: it has been noted the elevated amount of Ca from 0,99 mmol/l before treatment to 1,34 (in 1,4 times) mmol/l; the average index of K has been elevated from 2,3 mmol/l to 3,5 mmol/l (in 1,5 time) and the average index of Cl has been elevated from 149,3 mmol/l to 165,3 mmol/l (in 1,1 time) (Fig. 3).

Figure 3.

Changes of the composites of macro- and microelements (Ca, K, Cl) in the cerebrospinal fluid in patients with the outcomes of the TBI

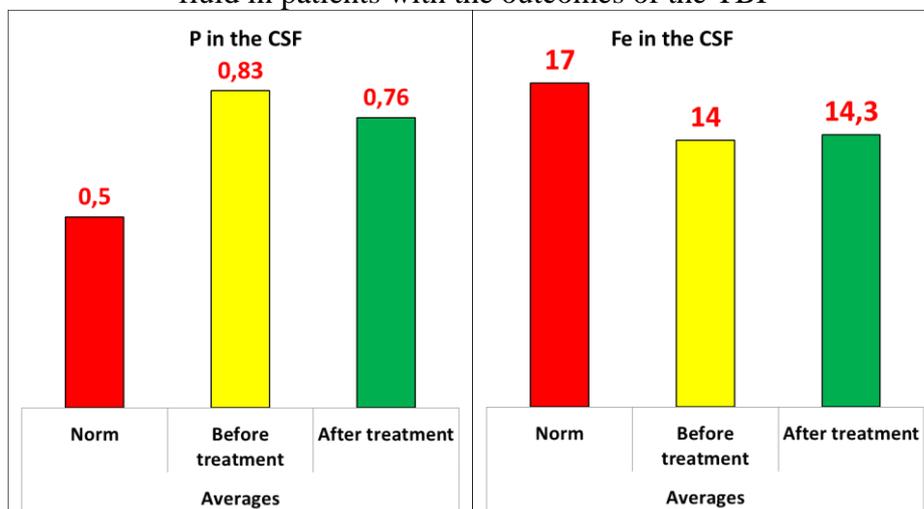


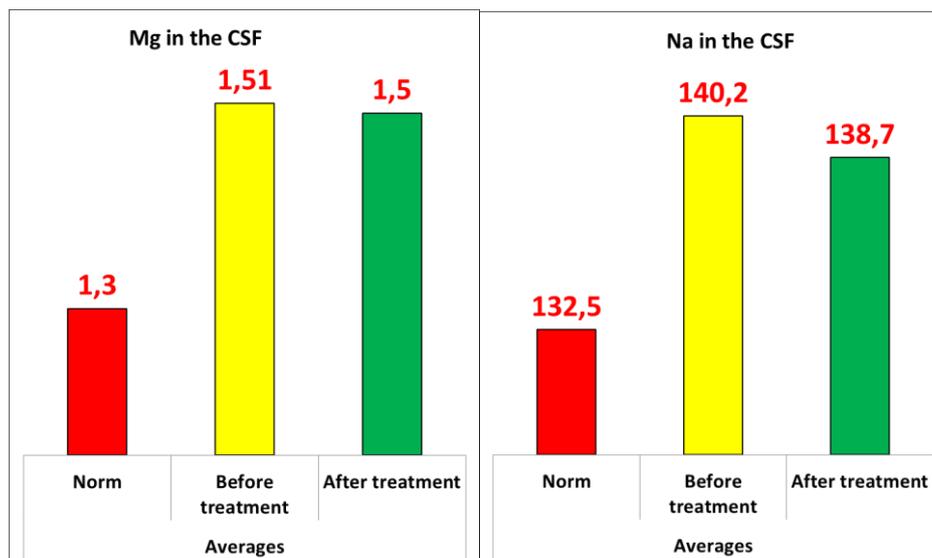


It has been noted reduction of the average indexes of macro- and microelements which according to the quantitative indexes were up to the normal values: the amount of P was reduced from 0,56 mmol/l to 0,53 mmol/l, the amount of Na was reduced from 140,2 mmol/l to 138,7 mmol/l and the amount of Mg was reduced from 1,51 mmol/l to 1,5 mmol/l (Fig. 4.).

Figure 4.

Changes of the composites of macro- and microelements (P, Fe, Mg, Na) in the cerebrospinal fluid in patients with the outcomes of the TBI





4. CONCLUSIONS

– Quantitative changes of macro- and microelements in the cerebrospinal fluid in patients with the different outcomes of the traumatic brain injury could cause criterion of the metabolic disorders in the patients' organism and could be the index of the clinical-neurological pathological changes.

– The investigation of the indexes of macro- and microelements in dynamics in patients with the outcomes of the traumatic brain injury could give us the possibility to determine the effectiveness of the pathogenetical treatment of patients.

– Endocystal introduction of ozone and endolumbar insufflation of ozone and introduction of nootropics led to the normalization of macro- and microelements in the blood and in cerebrospinal fluid because of the metabolic improvement in the organism and it could allow us to reach the early restoration of clinical-neurological disorders in patients with the outcomes of the traumatic brain injury.

– Thus, it may be noted positive changes in the metabolism of macro- and microelements in the cerebrospinal fluid of patients with various outcomes of TBI who were treated according to our suggested methods – endolumbar nootropic with ozone introduction and endocystal ozone admission.

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