RESULTS OF TREATMENT OF PARTIAL OPTIC NERVE ATROPHY OF VARIOUS ORIGINS IN CHILDREN

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Abstract. *Despite the modern advances in ophthalmology, low vision, blindness and visual impairment remain at a fairly low level. So, according to WHO, about 150 million people in the world suffer from visual disorders, including 43 million who are completely blind. It should also be noted that over the last more than 20-year period, the number of untainted people has increased by 12 million people.*

Keywords: *optic nerve, metabolic disorders, retinopathy of prematurity, head injury.*

Introduction. Despite the modern advances in ophthalmology, low vision, blindness and visual impairment remain at a fairly low level. So, according to WHO, about 150 million people in the world suffer from visual disorders, including 43 million who are completely blind. It should also be noted that over the last more than 20-year period, the number of untainted people has increased by 12 million people.

Among the main causes of irreversible vision loss and the development of blindness, pathology of the optic nerve occupies one of the leading places. Patients with this pathology account for an average of 19-20% of the blind population. Primary disability as a result of optic nerve atrophy, as a consequence of various diseases of the organ of vision, has almost doubled, which is of very important social significance, since 75% of visually impaired people are people of working age, including more than 50% with high intellectual level. With this pathology, up to 85 - 95% of visually impaired people need medical rehabilitation.

The pathogenesis of optic nerve atrophy is complex and ambiguous. Most authors are inclined to believe that optic nerve atrophy has a multifactorial nature. The most common causes of partial optic nerve atrophy (PONA) in children are infectious inflammatory diseases of the central nervous system (up to 40% of cases), hydrocephalus of various origins, brain tumors, congenital diseases of the central nervous system, metabolic disorders, retinopathy of prematurity, head injury, etc. Partial atrophy optic nerve disorder can be congenital and hereditary, primary and secondary. In this regard, the study of the clinic, pathogenesis, etiology, as well as the development of methods for treating this disease is a relevant and important problem in ophthalmology.

Treatment of partial optic nerve atrophy (PONA) remains one of the important areas in ophthalmology. Treatment methods for PONA are developing in the direction of improving blood circulation, increasing the level of tissue metabolism, creating biochemical, energetic, and functional conditions to improve the conduction of rhythmic excitation along the optic nerve. According to various authors, the positive effect of “traditional” conservative therapy for PONA

is observed in 21.4-63.4% of treated patients. The problem of delivering drugs to the optic nerve and creating their sufficient concentration, taking into account the presence of histohematic barriers, remains a serious problem.

Increasing the effectiveness of treatment can be achieved by introducing drugs to the posterior pole of the eye using various irrigation systems. To facilitate the diffusion of drugs into the tissues of the eye and optic nerves, electrophoresis and laser phoresis are used. Methods for using direct electrophoresis and laser phoresis of drugs in pathology of the posterior segment of the eye are described.

To increase the effectiveness of treatment for diseases of the optic nerve, along with pharmacotherapy, various methods of electrical stimulation and laser stimulation of the optic nerve are quite successfully used. A method of direct electrical stimulation of the optic nerve together with laser stimulation with a helium-neon laser has been proposed: using a model of optic nerve atrophy in rabbits, it has been established that the myelin sheaths are reconstructed around the preserved axial cylinders.

Based on the above, it can be assumed that the problem of partial atrophy of the optic nerve is far from being completely resolved.

The aim of the research. To study the results of an analysis of the treatment of children with partial atrophy of the optic nerve of various origins.

Materials and methods. We examined 36 children (64 eyes), hospitalized in the eye department of the TashPMI clinic and examined in the outpatient clinic of the centre neurosurgery. Of these, boys accounted for 53% (19 children), girls - 47% (17 children). The age of the studied patients varied from 2 to 17 years; the average age was 12 years. Of all requests, 17% (6 children, 9 eyes) are secondary atrophy of the optic disc. 15 children (42%) received transcranial magnetic stimulation as part of the complex treatment of partial atrophy, and 21 children (58%) received conservative treatment.

All children underwent neuro-ophthalmological (visiometry, biomicroscopy, perimetry, ophthalmoscopy, optical coherent tomography, visually evoked potentials), clinical and laboratory research methods, as well as consultations with related specialists (ENT, pediatrician, neurosurgeon).

Transcranial magnetic stimulation (TMS) is a noninvasive form of brain stimulation in which a changing magnetic field is used to induce an electric current at a specific area of the brain through electromagnetic induction. An electric pulse generator, or stimulator, is connected to a magnetic coil connected to the scalp. The stimulator generates a changing electric current within the coil which creates a varying magnetic field, inducing a current within a region in the brain itself.

Transcranial magnetic stimulation is a method based on stimulating brain neurons with an alternating magnetic field and recording responses to stimulation using electromyography. Its essence lies in the depolarization of nerve cell membranes under the influence of a strong magnetic field. Rhythmic TMS (rTMS) is a type of stimulation that generates a series of pulses that range in frequency from 1 to 100 Hz. There are two main rTMS modes: low-frequency (<1 Hz) and high-frequency (>5 Hz). Low-frequency magnetic stimulation causes a decrease in the excitability of neurons in the cerebral cortex, which leads to an inhibitory aftereffect, and high-frequency magnetic stimulation causes its increase, which has a stimulating effect. There are also “pattern” stimulation modes (intermittent theta burst stimulation - iTBS, continuous theta burst stimulation

- cTBS), in which stimuli are presented in the form of specific clusters. The duration of the rTMS aftereffect is proportional to the duration of stimulation, the total number of stimuli and the frequency of sessions [4]. The physiological (therapeutic) effect of rTMS and long-term (up to 3 months) aftereffect are traditionally associated with changes in synaptic plasticity due to the phenomena of long-term potentiation and depression.

Results. The main group consisted of 21 patients (35 eyes) with PONA, the control group - 15 patients (29 eyes). Patients in each of the two groups were divided into three subgroups according to the etiology of PONA: subgroup I consisted of patients with PONA due to pathology of the central nervous system (consequences of intoxication, traumatic brain injury, demyelinating processes, neurosurgical interventions, congenital disorders); Subgroup II consisted of patients with PONA due to retinal pathology (central chorioretinal dystrophy, retinal pigment abiotrophy); In subgroup III we combined patients with pathology of the optic nerve that developed in the long term after acute disorders of the blood supply to the optic nerve and retina (anterior ischemic neuropathies, posterior ischemic neuropathies, thrombosis of the central retinal vein and its branches, occlusion of the central retinal artery and its branches).

Treatment was carried out as pathogenetically as possible, taking into account the underlying disease and was aimed at improving blood circulation and stimulating the vital activity of surviving but depressed nerve fibers.

In the main group, traditional therapy was used to treat patients with PONA, consisting of: 1) nootropics (piracetam, etc.); 2) vasodilators (no-spa, papaverine, nicotinic acid, cavinton, etc.); 3) antioxidants (vitamin A, vitamin E, lipoic acid, blueberry forte, etc.); 4) angioprotectors (emoxipin, etc.); 5) polypeptides (cortexin, retinalamine); 6) neurotrophics (B vitamins, taufon, cerebrolysin).

In the control group, treatment was carried out in combination with transcranial magnetic stimulation. Patients were monitored on an outpatient basis throughout the entire treatment period. The session of transcranial magnetic stimulation lasted 10 days for 30 minutes.

We carried out dynamic monitoring of patients with PONA who were treated. The results obtained were assessed 1 and 3 months after treatment.

Assessing the results of the treatment, one can note better functional results according to the “visual acuity” criterion in subgroups II and III of the control group compared to patients of the main group. In patients with PONA due to pathological changes in the retina and circulatory disorders of the retinal vessels and optic nerve, it was possible to achieve an improvement in visual acuity by 60 and 47%, respectively.

One of the objective methods for assessing functional changes in visual functions was the quantitative assessment of the reduction in the number of absolute and relative scotomas when performing computer perimetry. We were able to achieve the highest results in the third experimental subgroup, where the number of absolute scotomas decreased by an average of 25%, and relative scotomas of the 1st and 2nd orders - by 58.4%.

An increase in visual acuity and electrical lability indicators indicated an improvement in the functioning of the axial fascicle of the optic nerve. An increase in the average amplitude values, a decrease in the average latency values of the P100 VEP wave, along with an increase in the average lability values, indicated an improvement in the parameters of the conduction of rhythmic excitation along the optic nerve. The differences turned out to be statistically significant according to the paired Student’s test ($p < 0.05$) when determined before and after treatment in both groups.

Table 1.

Dynamics of average visual acuity values before and after treatment, 3 months. (N±n)

	Main group			Control group		
	I	II	III	I	II	III
before treatment	0,17 ± 0,05*	0,25 ± 0,09*	0,17 ± 0,15*	0,16 ± 0,05	0,31 ± 0,15*	0,16 ± 0,03*
before treatment	0,23 ± 0,07*	0,4 ± 0,15*	0,25 ± 0,05*	0,19 ± 0,06	0,39 ± 0,02*	0,21 ± 0,02*
Enhancement Gradient	0,06	0,15	0,08	0,03	0,08	0,05
% improvement	35,3	60	47	18,7	25,8	31,2
*$p < 0,05$, significant differences before and after treatment						

In general, functional indicators were significantly higher in patients treated with the combined treatment method compared to the group treated with the traditional method. There was an improvement in the functioning of the axial bundle of the optic nerve (increase in the average value of visual acuity, improvement in electrolability indicators), improvement in the functioning of optic nerve fibers coming from the periphery of the retina (decrease in the average value of absolute and relative scotomas, improvement in the amplitude and temporal characteristics of the VEP).

Conclusion. Thus, the data presented in our work convincingly confirm the fairly high effectiveness of the developed method of treating PONA, based on transcranial magnetic stimulation of the optic nerve, which allows for controlled stimulation treatment on an outpatient basis. The original method of treating patients with various forms of PONA that we have developed ensures the achievement of good results in a complex category of patients with pathology of the optic nerve and retina and determines the prospects for the further development of this method of treatment and the widespread introduction of the original method into clinical practice. Combined treatment of partial optic nerve atrophy in children can improve visual functions and stabilize the process.

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