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CLINICAL CHARACTERISTICS OF INFLAMMATORY DISEASES OF THE OPTIC NERVE AND RATIONALE OF COMPLEX TREATMENT

(monograph)

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Annotatsiya

Ko’ruv nervi yallig’lanishini kompleks davolashda neyroprotektiv terapiyadan erta foydalanish ko’z tubidagi klinik, funktsional va ob'ektiv ko'rsatkichlarni yaxshilashga imkon beradi, bu esa ko’ruv nervi diski giperemiyasi bosqichidagi bemorlarda 79,7% hollarda, 68,4% - shishish bosqichida, 50% da - ishemiya bosqichida va 13,6% hollarda ko’ruv nervi diskining atrofiyasi bosqichida ijobiy natijaga erishishga imkon beradi.

Аннотация

Раннее применение нейропротекторной терапии в комплексном лечении воспаления зрительного нерва позволяет улучшить клинико-функциональные и объективные показатели глазного дна, что в 79,7% случаев у пациентов в стадии гиперемии ДЗН, в 68,4% - в стадии отека, в 50% - в стадии ишемии и в 13,6% случаев позволяет добиться положительного результата в стадии атрофии ДЗН.

Annotation

The early use of neuroprotective therapy in the complex treatment of optic nerve inflammation allows to improve the clinical, functional and objective parameters of the fundus, which in 79.7% of cases in patients at the stage of optic disc hyperemia, 68.4 % - in the stage of swelling, in 50% - in the stage of ischemia, and in 13.6% of cases, it allows to achieve a positive result in the stage of atrophy of the optic nerve disc.

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LIST OF ABBREVIATIONS

IDON - inflammatory diseases of the optic nerve

HSV-1 (2) - herpes simplex virus type 1 (type 2)

OD - optic disc

VEP - visual evoked potentials

ON - optic nerve

VR - visual radiation

MDC - measured diffusion coefficient

CP - computed perimetry

MRI - magnetic resonance imaging

MRT - magnetic resonance tractography

ON - optic neuritis

NRP - neuroretinal zonule

VA - visual acuity

OCT - optical coherence tomography

OCL - optochiasmal leptomeningitis

AIN - anterior ischemic neuropathy

VF - visual field

RBN - retrobulbar neuritis

MS - multiple sclerosis

TVFL - total visual field limit

RNFL - retinal nerve fiber layer

CRP – C-reactive protein

FA – fractional anisotropy

CMV – cytomegalovirus

MD – mean deviation of retinal sensitivity

PSD–pattern standard deviation

INTRODUCTION

Relevance and demand for the topic of the dissertation. Improving the methods of diagnostics and treatment of inflammatory diseases of the optic nerve (IDON) today are of particular importance on a global scale. According to the World Health Organization, complications of IDON account for 28% of the causes of eye disability. The spread of this disease among the working-age population, severe course, in 20-40% of cases the development of optic nerve atrophy (ON) leads to the development of irreversible visual impairment. In more than 22% of cases, loss of working capacity and disability develop, thereby reducing the quality of life of patients [129, pp. 175-180]. In the field of scientific research, determining the characteristics of the course of various stages of IDON, establishing the etiopathogenesis of ON inflammation and optimizing treatment methods remains one of the most important problems in ophthalmology.

In the world, the development of new highly informative and accessible methods for diagnosing IDON is becoming one of the most important medical tasks. Clinical manifestations of the transition of the disease as a result of damage to nerve fibers to the atrophic stage with pallor of the optic nerve head in the fundus are not accurate and indicate the irreversibility of the process, and are also diagnosed late. To date, the methods for determining such neurodegenerative processes in the fundus have not been sufficiently studied, which determines the priority of studying the problem of early diagnosis of this disease. The choice of tactics for treating optic nerve head disease has so far been complicated by the polyetiology of the disease, the complexity of pathogenesis and the appointment of neuroprotective drugs after the stage of acute inflammation. According to literary data, by this time more than 36% of nerve fibers are irreversibly lost [198, pp. 1079-1082]. In this regard, improving early diagnostic methods and developing highly effective methods for treating optic nerve head disease remain relevant.

Over the years of Independence, targeted measures have been taken in our country to radically improve the quality of medical care for the population. The use of modern high-tech diagnostic methods in eye hospitals has led to positive results.

In this regard, clinical research works devoted to the study of risk factors, etiopathogenesis, diagnostics, treatment and prevention of MN diseases are being carried out in our Republic [31, p. 38]. As a result of the implemented measures, relapses of the disease decreased by 18%, the degree of disability due to complications of the disease decreased by 34%. Despite the targeted measures taken in the healthcare system, a number of problems remain in ophthalmology that require their solution. In 2017, the adoption of five priority development strategies in the Republic of Uzbekistan, in particular its fourth direction on social protection of the population and improvement of the healthcare system, is considered fundamental. According to this, early diagnosis and improvement of treatment of MN diseases is one of the priority areas in ophthalmology. Relevance of the problem. To date, the clinical picture and diagnostics of visual evoked potentials in multiple sclerosis have been studied (Romanova E.V., 2002), a computerized system for diagnosing visual evoked potential pathology has been proposed (Ioileva E.E., 2002), the clinical significance of ultrasound examination in diagnosing visual evoked potentials has been determined (Kuritsyna O.A., 2004), the role of topographic mapping of visual evoked potentials in diagnosing diseases of the optic pathway has been determined (Krivosheev A.A., 2008), risk factors and possibilities for predicting the chronic course of demyelinating retrobulbar neuritis have been determined (Kostiv V.Ya., 2009), and examination of the visual analyzer in multiple sclerosis has been improved (Kovalenko A.V., 2010). Despite a significant number of studies, the pathogenetic processes leading to the development of visual evoked potentials and the staging of the disease have not been sufficiently studied.

A number of scientific studies have been conducted in this area in Uzbekistan. Early diagnostics and differential diagnostics of optic nerve pathologies are conducted in the Republic of Uzbekistan under the supervision of Professor H.M. Kamilov. The professor and his students (Kasimova M.S., 2009) have solved the problems of remote perimetry, computerization of the database of inflammatory and ischemic lesions of the ON. However, studies on the

interpretation of the indicators of clinical and morphological diagnostic methods for optic nerve lesions have not been conducted. The emergence of a new technique based on magnetic resonance of the diffusion weighted sequence has prompted domestic and foreign researchers to actively study its capabilities in assessing the microstructural properties of the white matter of the brain. According to the research of foreign scientists, a number of scientific results were obtained, including: the role of diffusion-weighted MRI in the diagnosis of changes in brain matter at the microstructural level, which are not visible on traditional MR tractograms, was determined (Jenkins T.M. et al., 2010), an important role of studying MR tractography in the diagnosis of damage to the visual pathways in optic nerve diseases of demyelinating etiology was revealed (Zayed N.M. et al., 2010), in vivo biomarkers of axonal destruction and demyelination in optic nerve diseases were studied (Trip S.A., Schlottmann P.G., Jones S.J., 2007). It should be noted that among foreign scientists there is no consensus on the possibilities of MR tractography in the diagnosis and prognosis of the development of inflammatory diseases of the optic nerve. This requires studying the structural changes in the brain underlying the development of optic nerve diseases and improving the optimal diagnostic complexes. Taking into account the above, the substantiation of new clinical and morphological studies in IDON, improvement of prevention and treatment methods, study of etiopathogenetic causes and diagnostic problems in IDON, improvement of immunobiochemical, functional and methods, and development of new treatment regimens in IDON are considered necessary and important in practical terms.

Objective of the study: to determine the features of the course and improve the principles of treatment of inflammatory diseases of the optic nerve depending on the stage of the disease based on the clinical and functional indicators of the eye.

Research objectives:

to establish clinical and functional criteria for optic neuritis (ON) depending on the stage of the disease;

to determine the diagnostic significance of methods (MRI and MR tractography) for ON;

to study the effectiveness of complex treatment of ON by stages of the disease based on the clinical and functional indicators of the eye;

to develop an algorithm for diagnosis and principles of treatment of patients with ON.

The object of the study were 100 patients (118 eyes) with OPN and a control group - 18 healthy individuals.

Subject of the study: the results of clinical, ophthalmological, laboratory studies of patients with OPN and healthy people.

Research methods. In the course of the study, clinical, ophthalmological (general and special), laboratory and statistical methods were used.

The scientific novelty consists in the following:

objective preclinical criteria for the transition of the acute inflammatory stage of NDN to the neurodegenerative stage have been identified, which include the parameters of the VEP study, MR tractography;

the effectiveness and safety of early neuroprotective therapy for VDN has been substantiated and proven.

The practical significance consists in the following:

differential diagnostic criteria for NDN depending on the stage of the disease have been determined, based on modern technologies, they make it possible to diagnose and determine the causes of the disease;

principles of treatment using early neuroprotective therapy, a differentiated approach depending on the stage and etiology of the disease in VDN have been developed.

Reliability of the obtained results. The reliability of the study results has been confirmed by a sufficient number of patients, objective clinical, ophthalmological, laboratory studies and is based on modern scientific and practical concepts and approaches to the diagnosis and treatment of patients with VDN. The solution of the considered problems has been carried out using modern

proven, correct methods of medical statistics. The scientific and practical significance is as follows:

from a scientific point of view, the theoretical significance of the obtained results is substantiated, clinical and functional features of the course and possible complications of the disease are studied, new methods of examination and treatment principles are formed.

The practical value of the work is that the developed diagnostic algorithm is a promising direction in practical ophthalmology of the republic, provides reliable diagnostics of IDON and thereby contributes to increasing the effectiveness of treatment. The use of MR tractography in the diagnosis of IDON allows us to determine the spread of the neurodegenerative process with the definition of qualitative and quantitative indicators, which helps to prevent possible complications of OPTIC NEURITIS in the form of partial or complete atrophy of the ON, as well as blindness and disability.

Structure and volume of the dissertation: The structure of the dissertation consists of an introduction, four chapters, a conclusion, and a list of references.

CHAPTER I. MODERN PROBLEMS OF DIAGNOSIS AND TREATMENT OF IDON

(literature review)

1.1. Etiopathogenesis and classification of IDON

According to statistics, in most cases, inflammatory pathology of the optic nerve head affects young, able-bodied people. Moreover, in almost 25% of patients, the outcome of the disease ends with the development of optic nerve atrophy, accompanied by severe impairment of visual acuity and field of vision [12, pp. 11-14; 60, pp. 209-214; 61, p. 251]. According to literature, with the treatment carried out, only 18% of patients with optic nerve neuritis (ONN) end in stable recovery, without repeated relapses [111, pp. 1386-1389]. The causes of inflammatory pathology of the optic nerve head are varied. The main factors in the development of ONN are inflammatory processes in the paranasal sinuses (ethmoiditis, sinusitis, frontal sinusitis, sinusitis, etc.); inflammatory diseases of the brain and its membranes (encephalitis, meningitis, arachnoiditis); general acute and chronic infections; inflammatory diseases of the eye (keratitis, iridocyclitis, choroiditis); diseases and consequences of orbital trauma (phlegmon, periostitis), acute and chronic infections (flu, measles, chickenpox, brucellosis, mumps), foci of local inflammation (diseases of the teeth, nasopharynx), as well as diseases of internal organs, helminthic invasions, intoxications, metabolic diseases, etc. [67, p. 23; 79, p. 677-685; 90, p. 163-172]. According to G.D. Zhaboyedov (2006), among inflammatory diseases of the brain, various forms of inflammation of the meninges are of the most significant importance for the occurrence of inflammatory bowel disease. The author believes that neuritis is mainly observed in epidemic cerebral meningitis, serous meningitis and encephalitis [19, pp. 170-174].

Neuritis can occur as a result of the introduction of pathogens themselves or their toxins from local foci of inflammation into the ON. The bony canal of the ON borders on the posterior cells of the ethmoid labyrinth or the main sinus, and the ON is separated from the mucous membrane of the paranasal sinuses only by a very thin bone wall. These anatomical relationships create favorable conditions for

the transition of the inflammatory process from the paranasal sinuses to the ON [1, pp. 36-37].

According to the available literature, syphilis, typhus, tuberculosis, and malaria are also important among chronic infectious diseases in the development of IDON [108, pp. 1273-80]. And according to the results of studies by Clark D. et al. brucellosis, can also be the cause of inflammation of the optic nerve [123, pp. 573-580].

According to the literature, the causative agents of optic nerve inflammation can be: staphylococci and streptococci, causative agents of specific infections - gonorrhea, syphilis, diphtheria, brucellosis, toxoplasmosis, malaria, smallpox, typhus, influenza viruses, parainfluenza, herpes zoster, etc. [156, pp. 367-368].

Currently, it is believed that the cause of the development of optic nerve inflammation in children, as well as in adults, is MS [8, p. 528; 46, pp. 12-15; 48, p. 322; 137, pp. 259-264], which is observed in 20-80% of patients. The authors explain such frequent involvement of the ON in demyelinating processes in MS by the fact that the myelin sheath of this nerve, unlike other cranial and peripheral nerves, is most identical to the myelin sheath of the brain. According to observations of E.S. Avetisov et al. (2008), in the pathogenesis of the development of ON, inflammatory changes are manifested by fine-point infiltration and proliferation of cells. From the pia mater, the process passes into the layers of nerve fibers. When inflammation is localized in the trunk of the ON, the process is interstitial. Edema and tissue infiltration occur with the participation of leukocytes, lymphocytes and plasma cells with the further development of neovascularization and connective tissue. Nerve fibers are affected secondarily and may subsequently atrophy. Deterioration of visual functions is caused by degeneration of nerve fibers in the area of inflammation. After the process subsides, the functions of some nerve fibers can be restored, which explains the improvement in visual acuity [79, p. 677-685].

Classification of optic nerve diseases is a complex and multifaceted task. Repeated attempts have been made to classify optic nerve diseases based on

etiological, pathological, or clinical principles. The desire to classify based on etiological principles is not widely used, primarily because it is often impossible to determine the etiology of optic nerve inflammation. On the other hand, this is due to the fact that sometimes the same etiological factor can lead to the development of neuritis with completely different clinical pictures [36, p. 538].

optic nerve diseases are classified based on the ophthalmoscopic picture of the fundus: retrobulbar neuritis, in which the optic nerve head (ONH) has a normal appearance; optic nerve head (ONH) is characterized by hyperemia and edema of the disc of varying degrees, which can be accompanied by peripapillary hemorrhages; neuroretinitis - neuritis combined with inflammation of the retinal nerve fiber layer (RNFL); neurouveitis - NRN combined with inflammation of the choroid [74, p. 621].

Based on the etiopathogenetic aspects of the inflammatory process, Gilbert M. et al. [136, p. 529-534] proposed the following classification of ON: 1. Demyelinating; 2. Parainfectious, may be a consequence of a viral infection or vaccination; 3. Infectious, may be rhinogenous or associated with cat scratch disease, syphilis, Lyme disease, cryptococcal meningitis, AIDS and herpes zoster; 4. Autoimmune, associated with systemic autoimmune diseases. There is also the most optimal classification from the point of view of ophthalmoneurology (V.I. Morozov, 2010): a) Perineuritis - inflammation of the ON membranes; b) Peripheral neuritis - inflammation of the superficial (peripheral) parts of the ON; c) Axial neuritis – inflammation of the axial fibers of the ON; d) transverse neuritis – involvement of the entire diameter of the ON in the inflammatory process [66, pp. 25-26].

Recently, among practicing ophthalmologists, the classification of G.D. Zhaboyedov for 2006 has become widespread [19, pp. 170-174], according to which the following stages of inflammatory edema of the ON are distinguished during its inflammatory processes: 1 - stage of hyperemia of the optic nerve head; 2 - stage of swelling; 3 - stage of ischemia: 4 - gliosis-atrophic stage. This

classification is convenient for practical application and most fully reflects the course of the process.

Thus, a single, generally accepted classification of inflammatory edema of the ON does not exist to date, which significantly complicates the diagnosis of this disease. Meanwhile, the sequence and scope of diagnostic measures depend on the etiological factor and concomitant diseases. The differential diagnosis of OPTIC NEURITIS is of primary importance when prescribing a particular type of treatment, since inflammatory, autoimmune, and demyelinating OPTIC NEURITIS have a similar picture in the initial and final stages of disease development, which leads to loss of time or the choice of inadequate treatment. Such a circumstance dictates the need for careful differentiation of OPTIC NEURITIS for the subsequent selection of etiopathogenetically justified treatment of patients and the achievement of positive results.

1.2. Clinical and differential diagnostic features of the course of IDON

According to the available literature, the most characteristic clinical symptoms of NVD are decreased visual acuity (VA), pain when moving the eyeballs, and impaired color vision [76, pp. 71-74]. Other clinical signs may include impaired contrast sensitivity, decreased stereoscopic vision, changes in the visual field (VF), and the presence of central and paracentral scotomas.

The authors also describe the appearance of such visual symptoms as movement and sound-induced phosphenes (visual illusions in the form of luminous dots or figures) or a sign - sometimes called the Uthoff symptom or phenomenon - worsening of symptoms with an increase in temperature, physical activity [115, pp. 174-180].

The criteria for typical NVD according to J.C. Kattah (2005) are presented as follows: 1) age under 45 years; 2) eye pain, especially when moving; 3) rapid (from several hours to several days) deterioration of vision; 4) relative afferent pupillary defect; 5) central or paracentral scotoma; 6) incipient or fully developed, but not chronic edema of the optic disc; 7) cessation of visual deterioration after 7

(maximum 10) days; 8) a clear tendency to improve after 2-3 weeks [154, pp. 506-507; 182, pp. 1401-1405]. As the authors note, in most cases the development of NPD is unilateral, rarely - bilateral. The diagnosis of NPD is established in the presence of an acute or subacute decrease in VA in one eye, accompanied by pain when moving the eyeballs, with a duration of disorders of at least 24 hours. In this case, the degree of decrease in VA depends on inflammatory changes in the papillomacular bundle. Narrowing of the optic disc is usually noted, which can be concentric or more significant in one of the areas. Central and paracentral scotomas appear. Narrowing of the peripheral borders of the visual acuity may be combined with scotomas. Also characteristic is a sharp narrowing of the visual acuity for red, and sometimes a complete absence of color perception [119, pp. 789-793; 127, p. 212; 167, pp. 508-514]. According to observations by Ionkina I.V. (2013), pain during eye movement is experienced by 53% to 88% of patients diagnosed with RBN [28, pp. 9-16]. One study provided the following data: in 16% of cases, pain preceded a decrease in visual acuity, 62% of patients complained of pain both during and without eye movement, 21% noted pain only during eye movement. Local headaches in the eye area were reported by 22% of patients, and general headache by 13% [51, pp. 153-155].

Color vision impairment, dyschromatopsia, is always present in NON and is characterized by a decrease in the brightness and saturation of colors. Some patients feel that red has become darker, while others say that the color has become lighter. In the absence of damage to the macular area, color vision impairment is a very sensitive indicator of NON [41, pp. 42-44; 178, pp. 396-402].

Changes in the optic disc in acute neuritis are considered a common phenomenon. As the authors note, in 64% of NON cases the disc remains normal, while in 23% of cases edema is detected, in 18% - hyperemia, in 2% - hemorrhages in the optic disc area. In the recovery period, 6 months after the transferred NVN, the disc condition corresponds to the norm in 42% of cases, pallor of the temporal halves is noted in 28%, and general pallor of the disc in 18% of cases. A direct relationship between the degree of expression of changes in the optic nerve head

and visual impairment has not been established to date [112, pp. 145-147; 150, pp. 276-286].

With RBN, at the onset of the disease, the fundus may sometimes remain normal. More often, slight hyperemia of the optic nerve head is noted, its boundaries are unclear. These changes may be more pronounced, as in neuritis. RBN most often develops in one eye. The second eye may become ill some time after the first. Simultaneous disease of both eyes was rarely observed [53, pp. 3-18; 155, pp. 633-663; 186, pp. 1722-1729].

According to Kamilov H.M., in typical cases, the diagnosis of OPTIC NEURITIS does not present any difficulties. It is more difficult to diagnose mild neuritis without a decrease in visual functions and neuritis with edema. In these cases, it is necessary to differentiate from pseudoneuritis and congestive disc [31, p. 38; 35, p. 18]. It is known from the literature that pseudoneuritis is characterized by normal visual functions and the absence of changes during subsequent observations [99, p. 156].

N.K. Serova's studies were devoted to the differential diagnosis of neuritis and congestive optic nerve head. According to these studies, congestive optic nerve head is characterized by a grayish color of the disc with significant prominence into the vitreous body and dilated veins. With symptoms indicating increased intracranial pressure, confirmed by spinal puncture, the diagnosis is in favor of congestive disc [84, pp. 186-190; 85, pp. 27-32].

According to some authors, the most difficult is the differential diagnosis of neuritis from edema and complicated congestive disc, since in both cases visual functions change rapidly. Here, too, increased intracranial pressure can confirm the diagnosis of congestive disc [18, pp. 7-18; 66, pp. 25-26]. Differential diagnostics of NDN is also carried out with anterior ischemic neuropathy (AIN) [68, p. 412]. According to Ioileva E.E., the difference between neuritis and AIN lies in the colorimetric data, the dynamics of the process, the age of patients and visual field losses. According to the author, with neuritis, the optic disc is hyperemic, while with AIN it is pale. With neuritis, vision quickly declines and is also quickly

restored during anti-inflammatory therapy to 1.0, while with AIN, visual functions are rarely restored [27, pp. 31-34; 75, 45-52]. According to Kasymova M.S., one of the most clear criteria for differential diagnostics with the preservation of relatively high vision is the perception of red color, which is significantly and for a long time reduced with neuritis, despite the relatively favorable course. With AIN, there is usually no particular difference between the perception of one color or another [38, p. 39; 39, pp. 402-403; 40, pp. 98-100; 42, pp. 93-94]. Posterior ischemic neuropathy is much less common than PIN and is difficult to diagnose, since the disease picture is similar to RBN [4, p. 378]. In the acute stage of the disease, changes in the optic disc are absent both ophthalmoscopically and with FAGD [54, pp. 3-7; 55, pp. 7-19; 72, pp. 14-16]. According to Ioileva E.E., depending on the presence of concomitant diseases, there may be atherosclerotic changes in the retinal vessels, phenomena of proliferative diabetic retinopathy, hypertensive retinopathy, Elschnig spots and others [26, p. 44]. Thus, the analysis of the literature we studied showed that the clinical picture of OPTIC NEURITIS is multifaceted, the symptoms are often identical to the signs of other diseases, which significantly complicates the establishment of a correct diagnosis and timely prescription of adequate treatment. This circumstance dictates the need to introduce new, highly informative diagnostic methods into clinical practice, which could eliminate subjectivity and accelerate the process of early recognition of this disease.

1.3. Methods of diagnostics of IDON

By now, practical ophthalmology has at its disposal a huge number of instrumental, non-invasive methods for diagnosing ON diseases. The literature contains many works on functional research methods devoted to the diagnosis of ON diseases [5, pp. 285-286; 7, pp. 115-116; 14, pp. 5-14; 24, pp. 108-110; 32, p. 141; 33, pp. 71-74; 83, pp. 38-41]. In particular, the role of fluorescent angiography, computed perimetry and optical coherence tomography (OCT) in the diagnosis of ON diseases has been studied [22, p. 310; 56, pp. 7-18; 64, p. 21; 73,

pp. 68-69]. The role of computed tomography and MRI in the diagnosis of this pathology has been covered in detail [59, p. 71; 181, pp. 562-567]. The clinical significance of color Doppler mapping in the diagnosis of ON and retinal pathologies has also been studied [21, pp. 4-6; 44, pp. 3-5; 45, pp. 355-357; 80, pp. 10-13; 97, pp. 5-10; 98, p. 18].

1.3.1. Traditional methods of diagnostics of IDON

Traditional methods of diagnosing ON include classical ophthalmological examination methods: visometry, perimetry (static, kinetic), campimetry, examination of pupillary reactions to light, examination of color vision and light perception, visocontrastmetry, ophthalmoscopy [pp. 3-11; 57, pp. 46-49; 62, pp. 143; 69, pp. 128-139; 77, pp. 257-361; 95, pp. 170-180]. According to most authors, OCT provides the greatest assistance in the early diagnosis of pathological conditions of the ON [149, pp. 407-412; 179, pp. 790-794; 180, pp. 1373-7]. OCT diagnostics is considered the most valuable in terms of assessing the state of axons. Since axons within the retina are not covered with myelin, the retinal nerve fiber layer (RNFL) is an ideal structural object for observing and studying the process of neurodegeneration, neuroprotection, and possibly even neuroreparation. In contrast to the peripapillary zone, where the RNFL consists of axons, the macula also contains a significant proportion of retinal ganglion cell neurons (about 34% of the total macular volume) [117, pp. 1366-72; 138, pp. 1603-9; 141, pp. 305-314; 159, pp. 129-137]. Numerous studies have established the high diagnostic value of RNFL thinning in MS, both with and without OPTIC NEURITIS [153, pp. 841-849; 158, pp. 325-331; 168, pp. 978-986; 196, pp. 383-391]. In a number of studies, OCT demonstrated a reliable decrease in the thickness of the macular retina in patients with MS, which manifests itself against the background of OPTIC NEURITIS and without it [15, pp. 16-21; 71, pp. 32-36; 82, pp. 4-10; 125, 963-969; 142, 277-287; 184, pp. 302-308]. V. Ya. Kostiv, in the process of conducting her own studies, revealed that 63.3% of patients with chronic RBN had significantly smaller sizes of the area of the optic disc and its neuroretinal belt

compared to the group of patients with persistent remission of the disease. At the same time, the author notes a significantly smaller gradient of the difference in the area of the neuroretinal zonule of the optic nerve head of the affected and fellow eyes in the compared groups of patients with RBN [53, p. 3-18].

Consequently, there are many literary data on OCT for retinal nerve head of demyelinating etiology, but there are none for retinal nerve head of inflammatory etiology, especially by disease stage, and there are no data before and after treatment.

Thus, at present, the arsenal of diagnostic methods for retinal nerve head disease is quite impressive, although each of the above diagnostic methods has a number of shortcomings that prevent the diagnosis of retinal nerve head disease at the preclinical stage of the disease. Known diagnostic methods are mainly valuable at the obvious stage of disease development, when existing traditional treatment methods are not effective enough, there is also no assessment of methods by disease stage, which was the basis for studying the parameters of these methods for each stage of the disease and when monitoring the effectiveness of treatment.

1.4. Methods of treatment of patients with IDON

Despite significant progress in ophthalmology, the issues of treating optic nerve diseases remain unresolved. Currently, the understanding of the etiology and pathogenesis of inflammatory disorders in the optic nerve has expanded and deepened, but the treatment of patients with this pathology has not become less complex, and the therapy used has not become more effective.

In modern ophthalmology, there are several approaches to the treatment of optic nerve diseases. Decreased visual function due to optic nerve pathology requires immediate and long-term treatment. Moreover, depending on the nature of the optic nerve damage, treatment should be differentiated [2, pp. 25-26; 6, pp. 27-35; 96, pp. 209-207; 102, pp. 170-172].

Until the etiology of optic nerve disease is determined, treatment involves suppression of infection and inflammatory response, dehydration, desensitization,

improvement of metabolism in the central nervous system tissues, and immunocorrection [70, pp. 132-133; 172, pp. 155-165; 189, pp. 804-810]. The main direction of therapy for OPTIC NEURITIS remains etiopathogenetic, in close connection with the identified cause of the disease. In this case, first of all, doctors prescribe broad-spectrum antibiotics, sulfonamides. Along with this, antihistamines, local hormonal therapy are used, in severe cases - general, complex antiviral therapy for viral etiology of the disease - antiviral drugs (acyclovir, virolex, oftanide, ganciclovir, etc.) and interferonogenesis inducers (poludan, pyrogenal, amixin), as well as symptomatic therapy - detoxifying agents (glucose, hemodez, rheopolyglucin), drugs that improve oxidation-reduction and metabolic processes [11, pp. 9-14; 13, pp. 58-62; 49, pp. 59-60; 104, pp. 104].

Doctors widely use hormonal corticosteroid drugs that have a pronounced anti-inflammatory effect. They are administered parenterally, retrobulbarly and orally [50, pp. 390; 164, pp. 679-686; 173, pp. 727-732]. At the same time, they sanitize foci of local infection (diseases of the paranasal sinuses, chronic diseases of the teeth and gums, treatment of helminthiasis) [1, pp. 36-37]. Dehydration agents are used (intravenous administration of 40% glucose solution, orally Diacarb, intramuscularly Lasix, etc.), physiotherapy procedures [78, pp. 3-12]. In order to improve the trophism of the optic nerve, vitamins of group B and C are prescribed. After the acute symptoms have subsided, vasodilators (nicotinic acid, nikoshpan), vasoconstrictors (angiotrophin, dicynone, askorutin, etc.), as well as biogenic stimulants (aloe, FiBS, pyrogenal, autohemotherapy, blood transfusion) are widely used [10, pp. 49-54; 63, pp. 9-14]. To prevent scarring (in optic chiasmatic arachnoiditis), many authors [66, pp. 25-26; 85, pp. 27-32] prefer to use resorption therapy (lidase, vitreous body, etc.). In optic chiasmatic arachnoiditis, clinicians often use neurosurgical treatment. In this case, the adhesions around the optic nerve and chiasm are dissected. The operation is mainly performed before the development of optic nerve atrophy while maintaining residual visual acuity [84, pp. 186-190]. In the late stages, when symptoms of optic nerve atrophy appear, antispasmodics and angioprotectors acting at the level of microcirculation are

prescribed (trental, berlition, sermion, nicergoline, nicotinic acid, xanthinol). It is also considered advisable to use magnetic therapy, electrical and laser stimulation [17, p. 1; 29, pp. 17-22; 30, pp. 351-352; 34, pp. 254-255; 89, pp. 41-44; 92, pp. 6-9; 101, pp. 46-74]. The authors, during a multicenter study (Optic Neuritis Treatment Trial (ONTT)), assessed visual recovery after corticosteroid therapy. The degree of recovery was assessed after 6- and 12-month observation periods. According to the study results, patients were divided into three groups, depending on the drugs used. Group 1 received methylprednisolone intravenously (solumedrol 250 mg every 6 hours) for 3 days, followed by oral prednisolone for 11 days. Group 2 received prednisolone orally for 14 days. Group 3 received placebo [110, pp. 77-83; 198, pp. 1079-1082].

The results showed that in the group receiving intravenous methylprednisolone followed by oral prednisolone, the recovery of visual function was faster than in the placebo group. However, this treatment regimen did not affect the long-term results of visual function recovery and did not differ from the results obtained after a year in the group taking oral prednisolone and in the placebo group [163, p. 284]. Hickman S.J. in his work analyzed the effect of GCS and came to the conclusion about the effectiveness of intravenous GCS compared to oral administration [143, p. 951-956]. The use of peptide bioregulators is one of the priority areas in the treatment of IDON. According to the observations of many clinicians, cytomedins affect cellular and humoral immunity, lipid peroxidation, and increase the body's defense reactions regardless of the organs and tissues from which they were obtained. Cytomedines obtained from brain and retina tissues have the function of neuropeptides, they actively participate in the regulation of nervous tissue activity [9, pp. 17-20; 81, pp. 176-178; 151, pp. 99-113]. In the works of Ionkina I.V. the effectiveness of retinalamin in OPTIC NEURITIS of demyelinating etiology was studied. The author points out the high effectiveness of this drug in the treatment of OPTIC NEURITIS [28, pp. 9-16]. Neuropeptides play an important role in the functioning of nervous tissue. Endogenous formation of a neuropeptide in response to any change in the internal environment leads to the

release of a number of other peptides, for which the first is an inducer. According to scientists, this circumstance enhances and prolongs the effect of neuropeptides [3, pp. 46-49; 91, p. 40; 116, p. 213]. Examples of drugs in this group are cerebrolysin, semax, which is able to regulate the expression of neurotrophins 3,4,5 and BDNF and has proven itself in the treatment of GON [23, p. 216; 87, p. 32-33; 88, p. 157-159; 103, p. 43-45].

Thus, the problem of treating GN is that the time of administration of neuroprotectors has not been determined, treatment principles have not been developed, and the safety of drugs for GN has not been studied, which was the basis for conducting this study.

SUMMARY. Based on a review of the literature, it was found that idiopathic and demyelinating GN in the initial stage of the disease have a similar clinical picture, but subsequently, with demyelinating GN, an unfavorable outcome is observed. In this regard, a significant part of scientific works is devoted to the study of demyelinating diseases of the ON. The diagnostic significance of OCT, VEP and MRT studies in ON of demyelinating etiology has been sufficiently covered, but in ON of inflammatory etiology, in particular by disease stages, has not been studied.

In this regard, there is a need to study the effectiveness of using instrumental methods to determine the stage, predict disease outcomes and identify possible damage to the fellow eye, as well as the dynamic use of these methods in the course of treatment.

We did not find data on the treatment of ON of inflammatory etiology by stages of the pathological process, as well as the use of neuroprotective drugs in the early stages of the disease in the literature. In this regard, the search for and implementation of new treatment methods with a polydirectional etiotropic effect remains relevant, which in turn determines the need to study this problem. The above served as the basis for this study.

CHAPTER II. CHARACTERISTICS OF CLINICAL MATERIAL AND RESEARCH METHODS

2.1. General characteristics of the surveyed contingent

The clinical material was collected at the Andijan Medical Institute clinic. During the period 2019-2021, we examined and treated 100 patients (118 eyes) with inflammatory NON. The control group consisted of 18 practically healthy people without somatic pathology.

The criteria for including patients in the study contingent were:

1. Established diagnosis of NON.

2. Sick and healthy individuals who gave written informed consent to participate in the study.

3. Acute or recurrent course of the disease.

The diagnosis of NVN was established based on the anamnesis and examination results: decreased visual acuity; discomfort or pain when moving the eyeballs; impaired color vision; changes in the visual field in the form of concentric narrowing on white, absence or narrowing of the visual field on red; decreased afferent pupillary reflex; the presence of edema or other changes in the optic disc during ophthalmoscopy; changes in OCT (RNFL and NZ thickness, absence of physiological excavation); prolongation of latency and decrease in the P100 amplitude on VEP.

Exclusion criteria from the study:

1. Patients with concomitant diseases of the organ of vision that could affect the interpretation of the results (conjunctivitis, uveitis, glaucoma, dystrophic and other ischemic, vascular and oncological diseases of the eye).

2. Sarcoidosis, Behcet's disease, lymphoma.

3. Severe concomitant somatic pathology (clinically significant pathology of the cardiovascular, endocrine, respiratory system, gastrointestinal tract), complicating the performance of studies or interpretation of their results.

Among the patients, there were 44 men and 56 women. The distribution of patients by gender showed that women were sick more often (62.3%) than men (37.7%).

The age of patients ranged from 5 to 60 years, averaging 29.9±1.18 years for women and 31.3±1.68 years for men.

Table 2.1

Distribution of patients with IDON by age

Age (in years)											
To 10		*10-19*		*20-29*		*30-39*		40-49		50<	
Abs	%	Abs	%	Abs	%	Abs	%	Abs	%	Abs	%
2	2	21	21	39	39	19	19	12	12	7	7

As shown in Table 2.1, the majority of patients were aged 10 to 39 years (81%). The distribution of the patient contingent by social status showed a predominance of young, working-age individuals (62%).

The formation of groups depending on the etiology, stage of the disease, severity, and clinical and functional manifestations was homogeneous.

When distributing 100 patients (118 eyes, with optic nerve edema of inflammatory etiology) into groups, we used the classification of G.D. Zhaboyedov of 2006 (Ukraine, Kiev) [19], according to which 4 groups of patients were identified depending on the stage of inflammatory edema of the optic nerve: Group 1, 31 eyes in the stage of optic nerve head hyperemia; Group 2, 31 eyes in the stage of optic nerve head swelling; Group 3, 30 eyes in the stage of ischemia; Group 4, 8 eyes with the gliotic-atrophic stage of the disease. In our opinion, this classification most fully reflects the course of the pathological process in the optic nerve and is convenient for practical application (Fig. 2.1). The control group consisted of 12 patients (24 eyes).

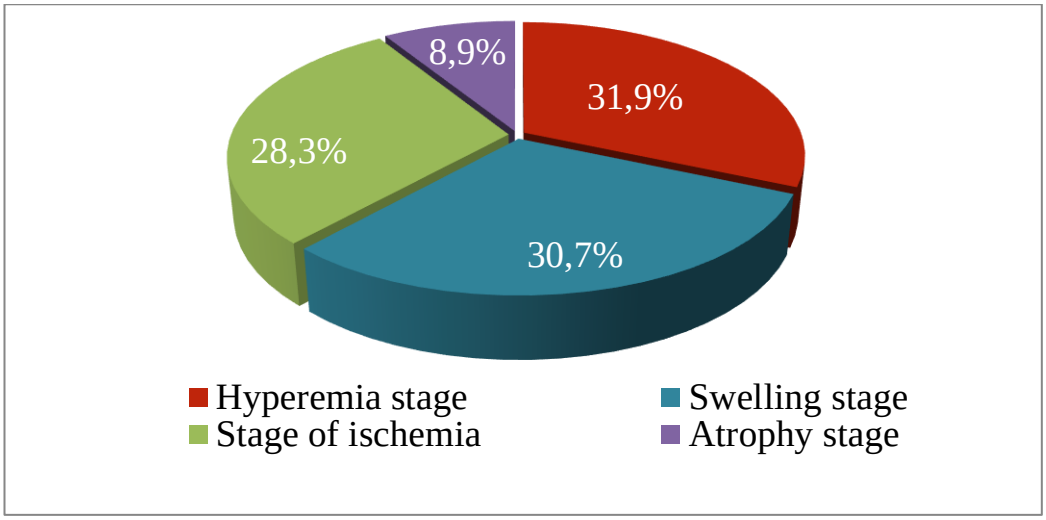


Fig. 2.1. Distribution of patients with IDON by disease stage.

Depending on the type of treatment, 2 groups of patients were taken.

In the control group of 12 patients (24 eyes), traditional treatment was used: anti-inflammatory, anti-edematous, desensitizing, antibiotic therapy, and also antiviral therapy if indicated.

In the main (1, 2, 3, 4 - subgroups) group of 100 patients (118 eyes), complex treatment with the addition of neuroprotective therapy was used. The main difference from the standard treatment was a differentiated approach depending on the stage of the disease and early use of a neuroprotective drug, i.e. from the first day of the patient's admission to the hospital.

All examined patients after the initial ophthalmological examination, if necessary, underwent consultations with other specialists, in particular, a therapist, neurologist, endocrinologist, neurosurgeon, otolaryngologist, rheumatologist, infectious disease specialist, immunologist.

2.2. Clinical and functional studies

Clinical and functional studies of patients with IDON were conducted in accordance with the requirements of the “Standards of Diagnostics and Treatment in Ophthalmology” of the Ministry of Health of the Republic of Uzbekistan (Table 2.2).

Table 2.2.

General structure and volume of studies, patients (number of eyes)

Research methods	Patients withIDON	Control (healthy people)	Total
Functional methods			
1.Visometry	100(118)	18 (36)	118 (154)
2. Kinetic perimetry for white color	100 (118)	18 (36)	118 (154)
-on red color	100 (118)	18 (36)	118 (154)
Objective methods			
3.Static computer perimetry	29 (29)	10 (20)	39 (39)
4. Refractometers	100 (118)	18 (36)	118 (154)
5. Biomicroscopy	100 (118)	18 (36)	118 (154)
6. Ophthalmoscopy	100 (118)	18 (36)	118 (154)
7. OCT	51 (67)	10 (10)	61 (77)
Electrophysiological methods			
8.VEP on chess pattern	53 (90)	10 (20)	63 (110)
9.ERG	53 (90)	10 (20)	63 (110)
Research methods			
10. MRI of the brain	80	8	88
11.МР– трактография	50	10	60

Laboratory research methods			
12. Complete blood count	80	8	88
13. General urine analysis	80	8	88
14.Urine analysis according to Nechiporenko	80	8	88
15. Rheumatic tests	80	8	88
16. Analysis for TORCH infections	80	8	88
17. General immunogram	18	10	28

2.2.1. Ophthalmological research methods

1. Visometry - visual acuity was determined using the Roth device using Snellen tables or Landolt rings;

2. Perimetry. Computer static perimetry was performed using the Humphrey Field Analyzer 740 i perimeter (Carl Zeiss Meditec Inc.) using the 30-2 central threshold test program. All results were recorded using digital marking with a general analysis of the MD (mean deviation of retinal light sensitivity) and PSD (standard deviation pattern) indices.

3. Color vision testing. The testing was performed using Polyak polychromatic tables and the Neuroimpulse device with adjustable intensity of green, red and blue LEDs from 1 to 10 conventional units.

4. Light perception testing was performed with alternate illumination of the healthy and diseased eyes or simultaneous illumination of both eyes. The patient indicates where the perception of light is reduced or increased (lighter-darker).

5. Determination of pupillary reactions. The study was conducted in a dimly lit room with the patient looking into the distance, a spotlight was used. Direct, consensual pupillary reactions to light, as well as reactions to convergence and accommodation were studied.

6. Biomicroscopy of the cornea and conjunctiva was performed using a slit lamp M 211 (Carl Zeiss Jena GmbH, Germany).

7. Ophthalmoscopy of the fundus was performed using an ophthalmoscope from Heine (Germany) and a fundus camera from Karl Zeiss (Germany) with photo recording and image analysis. 8. Tonometry was performed using the non-contact pneumotonometry method using the Kowa device (Japan); if necessary, the Maklakov TGD-01 intraocular pressure tonometer (mod. 352, NGM 2 set - "OFT-P", Krasnogvardeets OJSC, Russia) was used; portable IGD device.

8. Optical coherence tomography (OCT) with confocal scanning laser examination was performed using a Cirrus HD - OCT tomograph (Zeiss, Spectral Domain Technology) of the optic disc area (ONH protocol) and the macular area (GCC). The scanning protocol for assessing the retinal nerve fiber layers (RNFL) "RNFL thickness" and the macular area was used, according to which the RNFL was defined as 3.4 mm in diameter. The results of scanning the peripapillary RNFL were processed according to the analysis protocol "RNFL thickness average OU" and "RNFL thickness single eye". The average foveal thickness (μm) and macular volume (mm^3) of the retina were calculated automatically using the RNFL thickness/Volume Tabular and Retinal map single eye research protocols included in the tomograph software package. Both protocols are standard for RNFL assessment and allow statistical comparison of the results with an extensive normative database. The used analysis protocol determines a large number of quantitative parameters characterizing the RNFL thickness in each of the 12 sectors, 4 quadrants (superior, inferior, nasal and temporal) and the average for the entire circumference [71, pp. 32-36]. The parameters of focal and global retinal ganglion cell complex losses (FLV and GLV, respectively) were also determined. The FLV (focal ganglion cell loss volume) parameter is defined as the average deviation from the normative values for areas with significant GGC losses. The level of focal losses is measured in % and reflects the amplitude (depth) of GCS losses – a certain analogy with the PSD parameter in perimetry. The GLV (global ganglion cell loss volume) parameter is defined as the sum of all relative defects

normalized to the total area of the measurement map – i.e. the averaged percentage of GCS complex losses over the area (analogy with the MD parameter in perimetry) [79, pp. 677-685].

2.2.2. Special research methods

1. MRI of the brain. The basic topical diagnosis was established based on the analysis of MRI data performed using a BRIVO-355 / 1.5 Tesla GE (USA) tomograph with a magnetic field induction of 1.5 T. The patients underwent a standard MRI scanning procedure in order to determine the localization and structure of the inflammation focus using axial T1 and T2 weighted scanning modes.

2. MR tractography was performed on a BRIVO-355 / 1.5 Tesla GE (USA) magnetic resonance tomograph in the STARMED and CITIMED clinics. Both individual conduction pathways and a comprehensive picture of the white matter tracts as a whole were constructed.

The study protocol included standard programs (TISE, T2SE, FLAIR), as well as targeted visualization of the optic tracts with the possibility of post-processing and obtaining images in various planes. Diffusion tensor images were obtained and processed using the built-in post-processing program (Neuro 3D), which included the construction of fractional anisotropy (FA) maps, the measured diffusion coefficient (MDC), the diffusion tensor, and the reconstruction of conduction pathways in three-dimensional mode (tractography).

Data processing. After obtaining the MR images, the area of "interest" was selected, in which the tractograms were reconstructed. The area of interest was the optic nerve (ON) and the optic radiation (OR). Taking into account the literature data [107, pp. 5-9], these zones were highlighted with three circles with a diameter of 5 mm (Fig. 2.2.A). Then, the FA and MDC values were obtained on the FA maps (Fig. 2.2.B).

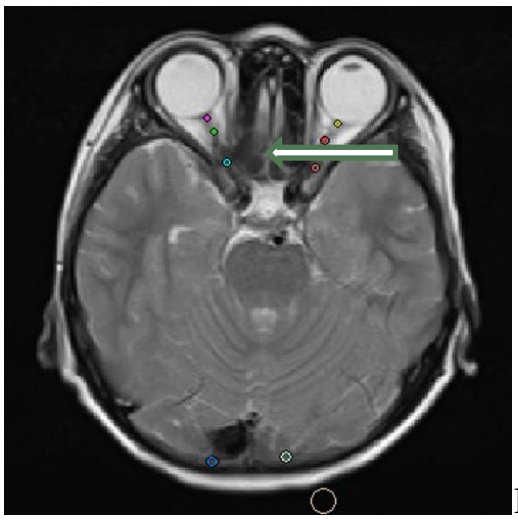
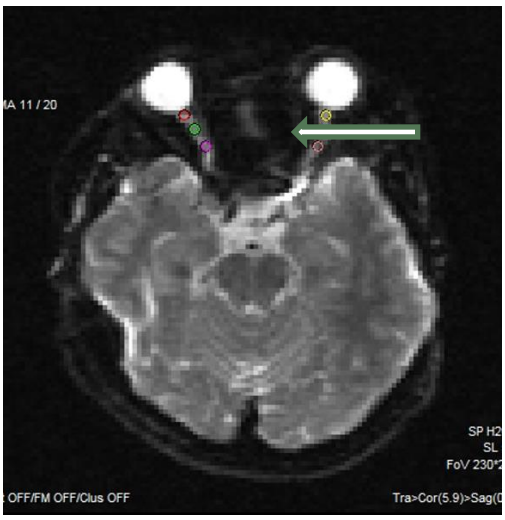
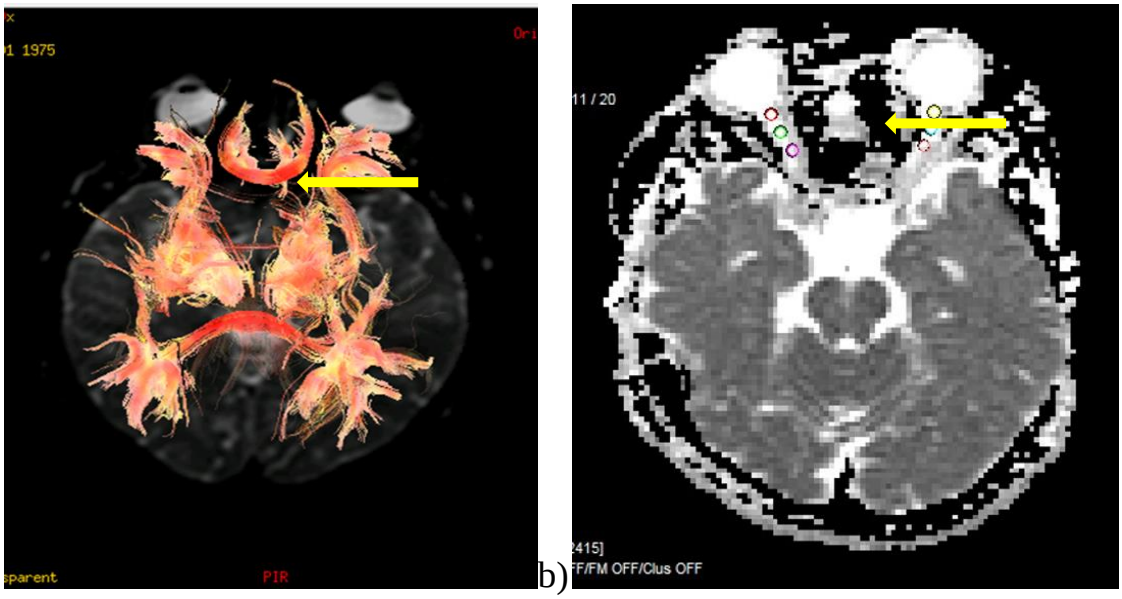
A)  B) 

Fig. 2.2. A) MRI of the brain. Selection of the region of interest in the projection of the optic nerve. B) FA map. Selection of the region of interest in the projection of the optic nerve on the fractional anisotropy map. FA is a value characterizing the integrity of the myelin sheath. MDC evaluates diffusion processes occurring in the longitudinal direction of the axon. Colored images were obtained in DEC (directional encoded color) maps (Fig. 2.3). In order to exclude as much as possible the receipt of false-positive results, color and black-and-white FA and DEC maps were used (Fig. 2.3).

On color maps, different directions of the diffusion tensor are displayed in corresponding colors. Thus, the conducted pathways of vertical orientation are displayed in blue, associative pathways of longitudinal orientation - green, and transverse - red. Such mapping made it possible to exclude the erroneous capture of fibers of neighboring tracts in the zone of interest [109, pp. 456-467].



a) b)

Fig. 2.3. DEC maps. Identification of areas of interest in the optic nerve region on color (a) and black-and-white (b) fractional anisotropy maps.

ID	FA Mean SDev Size / Min / Max	ADC Mean SDev Size / Min / Max	TraceW Mean SDev Size / Min / Max	Anat Mean SDev Size / Min / Max
1	132.0 0.0 1 / 132 / 132	2398.0 0.0 1 / 2398 / 2398	26.0 0.0 1 / 26 / 26	480.7 211.0 3 / 331 / 779
2	118.0 0.0 1 / 118 / 118	2292.0 0.0 1 / 2292 / 2292	24.0 0.0 1 / 24 / 24	319.3 45.0 3 / 260 / 369
3	171.0 0.0 1 / 171 / 171	1823.0 0.0 1 / 1823 / 1823	25.0 0.0 1 / 25 / 25	286.5 55.5 2 / 231 / 342
4	149.0 0.0 1 / 149 / 149	1602.0 0.0 1 / 1602 / 1602	37.0 0.0 1 / 37 / 37	280.5 29.5 2 / 251 / 310
5	325.0 0.0 1 / 325 / 325	725.0 0.0 1 / 725 / 725	178.0 0.0 1 / 178 / 178	310.3 7.9 4 / 299 / 319
6	305.5 22.5 2 / 283 / 328	809.0 3.0 2 / 806 / 812	173.5 3.5 2 / 170 / 177	318.3 22.8 6 / 286 / 352

Fig. 2.4. Table for calculating the FA and MDC indicators.

A quantitative assessment of the conduction pathways of the ON and VR was performed, which consisted of an analysis of the measured diffusion coefficient (MDC) and FA values obtained in the specified zones (Fig. 2.4). Statistical processing of the obtained values was performed and they were compared with the control group. The zones of interest for measurement in the control group were selected in accordance with those in the patient groups. In each group, the mean value and standard deviation of the FA values for each zone were calculated separately.

2.2.3. Laboratory research methods

1. Complete blood count - according to the standard Panchenkov method (capillary photometry method).

2. Complete urine analysis and urine analysis according to Nechiporenko. The "dry chemistry" method with microscopy was used.

3. Rheumatological tests with the study of ASLO, C-reactive protein, rheumatoid factor. The standard method was used.

5. ELISA blood test for herpes simplex viruses (HSV), cytomegalovirus (CMV), toxoplasmosis. Solid-phase chemiluminescent enzyme immunoassay was used.

6. Markers of immunocompetent cells (CD3+, CD4+, CD8+, CD16+, CD20+, CD25+, CD38+, CD95+) were determined using monoclonal antibodies (OOO Sorbent, Podolsk, Moscow Region). The functional state of the B-immune system was assessed by determining serum immunoglobulins of the main classes IgG, A, M using the generally accepted method of radial immunodiffusion in gel according to G. Mancini (1965) using sets of monospecific sera against IgG, A, M. Determination of circulating immune complexes of various sizes (CIC) was determined by the spectrophotometric method. Phagocytic activity of neutrophils was determined by the method of Mayansky A.N. et al. (1993). Determination of the level of IL-10 cytokine production was carried out using the test kits TO "Cytokine" and "Protein contour" (St. Petersburg).

2.3. Methods of statistical processing

Statistical processing of the obtained results was carried out using standard methods of variation statistics using Student's t-criterion to assess the reliability of differences. Average values are presented as M ± m (arithmetic mean ± standard error of the arithmetic mean). Differences satisfying $p < 0.05$, generally accepted for medical objects, were considered reliable. The reliability of the difference in the frequency of occurrence of nonparametric features in the groups was calculated using the $\chi 2$ criterion for 2x2 contingency tables and an assessment of reliability

according to statistical tables, taking into account the degree of freedom. Correlation analysis was carried out using the Pearson correlation coefficient and an assessment of its reliability according to statistical tables, taking into account the size of the groups. One-way analysis of variance (ANOVA), regression and comparative analysis were also used.

CHAPTER III. CLINICAL AND FUNCTIONAL STATE OF THE VISUAL ORGAN IN PATIENTS WITH IDON

3.1. Clinical and functional assessment of the visual organ in patients with IDON

Retrospective analysis showed significant variability in the clinical presentation, course and outcomes of OPTIC NEURITIS, in connection with which it was decided to divide patients with OPTIC NEURITIS by stages during a prospective study (100 patients, 118 eyes) and to identify clinical and functional features of the course of the process depending on the stage of the disease. We analyzed the incidence of OPTIC NEURITIS by etiology. As Table 3.1 shows, among the causes of OPTIC NEURITIS, viral diseases of the body (flu and colds, CMV, HSV) prevail - 32.7% and inflammation of the paranasal sinuses - 26.4%, while rheumatism and kidney diseases make up the smallest percentage (4.6 and 6.9%, respectively).

Table 3.1.

Distribution of patients by etiology of the process

Etiology	Abs	%
Viral diseases	27	27
Inflammation of the paranasal sinuses	26	26
Inflammatory diseases of the brain	10	10
Inflammatory eye diseases	4	4
Rheumatism	8	8
Kidney diseases	12	12
Mixed etiology (sinusitis + viruses)	13	13
Total	100	100,0

Anamnestic studies showed that the majority of those examined sought hospitalization at later stages of the pathological process. Thus, the time of admission to the hospital in the first 5 days from the onset of the disease was recorded in only 17 patients (17%), from 6 to 14 days - 33 (33%), from 15 to 29

days - 32 (32%), more than 1 month from the onset of the disease - 16 patients (16%). At the same time, the time of transition of the pathological process to the second eye averaged 7.7 ± 1.14 days.

It was also found that in 74 (74%) patients the diagnosis was first detected during our inpatient examination, and 26 (26%) patients had previously received unsuccessful treatment at their place of residence. In this case, the treatment included vasodilator therapy, antibiotic therapy, mildronate, emoxipine. The effect was unsatisfactory. The vast majority of patients with inflammatory NVD (100 patients, 118 eyes) mainly complained of impaired color perception (92.7%) and decreased visual acuity (90%). In addition, a thorough survey revealed the presence of such complaints as: lack of object vision - in 8 (8%) cases, pain when moving the eyeball and heaviness in the eye - in 18 (18%), the presence of a spot and / or fog in front of the eye - in 21 (21%) cases. The difficulty of early diagnosis of inflammatory NVD also consisted in the heterogeneity of the primary clinical signs of the disease, as well as the non-specificity of complaints from patients. Thus, a decrease in VA fluctuated during the day, deterioration in visual performance manifested itself mainly during physical exertion, which was perceived by patients as a natural manifestation of fatigue. At the same time, some patients had such characteristic symptoms as narrowing of the peripheral field of vision, the appearance of a black spot in front of the eye, a feeling of discomfort, redness and heaviness in the eye, pain when moving the eyeballs, impaired color vision, etc. Such erased symptoms led to a delay in patients visiting a specialist and, accordingly, to an aggravation of the disease.

During the studies, a relapse of the disease was observed in sinusogenic and autoimmune neuritis, which is associated with a chronic, recurrent course of the underlying disease.

Thus, our studies have shown that among the etiological factors, flu and colds, diseases of the paranasal sinuses prevailed, a unilateral process was more often noted, the incidence was more often noted in women, it was more often

observed at a young age from 26 to 40, a relapse of the disease was observed in sinusogenic and autoimmune neuritis.

State of visual acuity. In the course of our studies, it was established that the indicators of visual acuity in patients with OPTIC NEURITIS varied significantly depending on the stage of the pathological process (Table 3.2).

Table 3.2.

State of visual acuity in patients with NVN

Visual acuity	**Groups**							
	1 (n=31)		**2(n=31)**		**3(n=30)**		**4 (n=8)**	
	Abs	%	Abs	%	Abs	%	Abs	%
0 (zero)	2	6,2	2	6,2	2	6,2	1	12,5
<0,09	4	12,4	4	12,4	4	12,4	1	12,5
0,1-0,3	7	21,1	7	21,1	7	21,1	6	75
0,4-0,6	9	29,8	9	29,8	8	27,8	-	0,0
0,7-1,0	9	29,8	9	29,8	9	29,8	-	0,0
Total	31	100,0	31	100,0	30	100,0	8	100,0
On average (M±m)	**0,48±0,04***		**0,29±0,04***		**0,24±0,03***		**0,06±0,01***	
Control group	0,9±0,02							

Where: * - the difference in results between the control and comparison groups is reliable ($p<0.05$).

It should be noted that some patients had various refractive errors, therefore, the table presents the VA indices with correction.

In group 1, VA upon admission was above 0.1 in 84.9% of cases, and among them, above 0.7 was found in 35.6% of cases. In group 2, VA above 0.1 was established in 59.2% of cases, of which above 0.7 in 14.5%. In group 3, VA above 0.1 was approximately the same and amounted to 57.1%, but above 0.7 was only in 7% of cases. In the atrophy stage (group 4), eyes with very low vision (0.01-0.09)

prevailed, which amounted to 72.7%, only in 27.6% was VA above 0.1. In this case, the visual acuity did not exceed 0.3.

When analyzing the table indicators, it is noteworthy that the number of patients with zero vision prevails in groups 2 and 3.

Color perception was impaired in 47.2% of cases in group 1, in 48.8% in group 2, in 67.3% in group 3, and in 49.4% in group 4. It was found that the perception of red is mainly impaired, which is confirmed by literary data and can serve as an additional differential diagnostic test when making a diagnosis. Our studies show that color perception suffers more in patients with stage II of the disease and directly depends on the severity of edema of the ON.

When examining **refraction**, emmetropic refraction was revealed in 72 (72%) eyes, myopic refraction in 18 (18%), and hypermetropic refraction in 10 (10%) eyes. It should be noted that in stage I of the disease, myopic refraction was detected in 10% of cases. These patients had previously been observed by ophthalmologists for accommodation spasm and mild myopia. When comparing refraction and the anterior-posterior size of the eye (APS), a discrepancy was noted in the data obtained. That is, with a small APS (less than 23 mm), myopic refraction from -0.5 to -2.0 D was observed. This circumstance is associated with significant edema of the retrobulbar part of the ON, which was restored during treatment, due to which the refraction became emmetropic.

During tonometry, the average IOP was 19.2 ± 0.12 mm Hg, i.e. no noticeable deviations from the norm were observed.

Visual field condition. When examining patients using kinetic and static perimetry methods, central and paracentral defects, varying degrees of peripheral limitations, which were combined with visual field defects in the central zone, were identified. In 21 cases, perimetry could not be performed due to the absence of object vision. The total boundaries of the peripheral visual field (PV) for a white object averaged 318.4±8.97, while for a red object they were 48.5±2.75 ($p<0.001$), indicating profound impairments in the perception of red color by the contingent of those examined (Table 3.3).

Table 3.3.

Visual field condition in patients with NVN

Field of view	**Groups**				
	1-group (n =31)	*2-group (n =31)*	*3-group (n =30)*	*4-group (n =8)*	*Control group*
PZ on white color	363,3±14,1*	299,2±18,5*	316,1±16,4*	244,5±33,9*	542,3±6,4
PZ on red	52,9±5,58*	43,15±4,75*	47,8±4,92*	37,7±8,4*	214,2±2,4

Where: * - the difference in results between the control and comparison groups is reliable ($p<0.05$).

Central or paracentral scotomas of various sizes and shapes were detected in 55 (22.2%) cases.

Significant violations of the boundaries of the visual acuity to white and red colors were established in the 2nd and 4th observation groups. In these groups, the visual acuity to white was concentrically narrowed by more than 20º and averaged 299.2±18.57º and 244.5±33.9º, respectively. Inversion of the visual acuity to red was revealed, i.e., the boundaries of the visual acuity to red are narrower than the boundaries of the green and blue colors in the 1st and 2nd groups. It should be noted that the visual acuity remained high (0.7-1.0). In total, visual acuity to red was not determined in 83 eyes. In groups 3 and 4, on the contrary, a narrowing of the FV boundaries to blue was noted, which indicated the transition of the acute pathological process to the ischemic stage. A fairly sensitive technique was the study of the central FV on computer perimetry, using which we identified a decrease in the threshold of light sensitivity, the presence of central and paracentral scotomas even with high VA and normal peripheral boundaries of the FV. A decrease in the average retinal light sensitivity index was established (Fig. 3.1). The average deviation MD was -14.1 ± 0.51 DB, the standard deviation PSD 7.75 ± 0.48 DB. It should be noted that the MD index was significantly lower in groups 3 and 4, the PSD index was increased in group 4 (Table 3.4).

Table 3.4.

Results of computer perimetry in patients with OPTIC NEURITIS (in dB)

Groups	**MD**	**PSD**
1 - group (n=14)	-8,13±0,62*	4,56±0,32*
2 - group (n=12)	-11,88±0,89*	9,13±0,40*
3 - group (n=10)	-14,08±0,38*	6,52±0,58*
4 - group (n=9)	-22,16±0,14*	10,8±0,62*
Control group (n=10)	-2,24±0,02	2,24±0,04

Where: * - the difference in results between the control and comparison groups is reliable ($p<0.05$).

In the ischemia and atrophy stage, a significant decrease in the threshold of light sensitivity of the retina and ON was revealed.

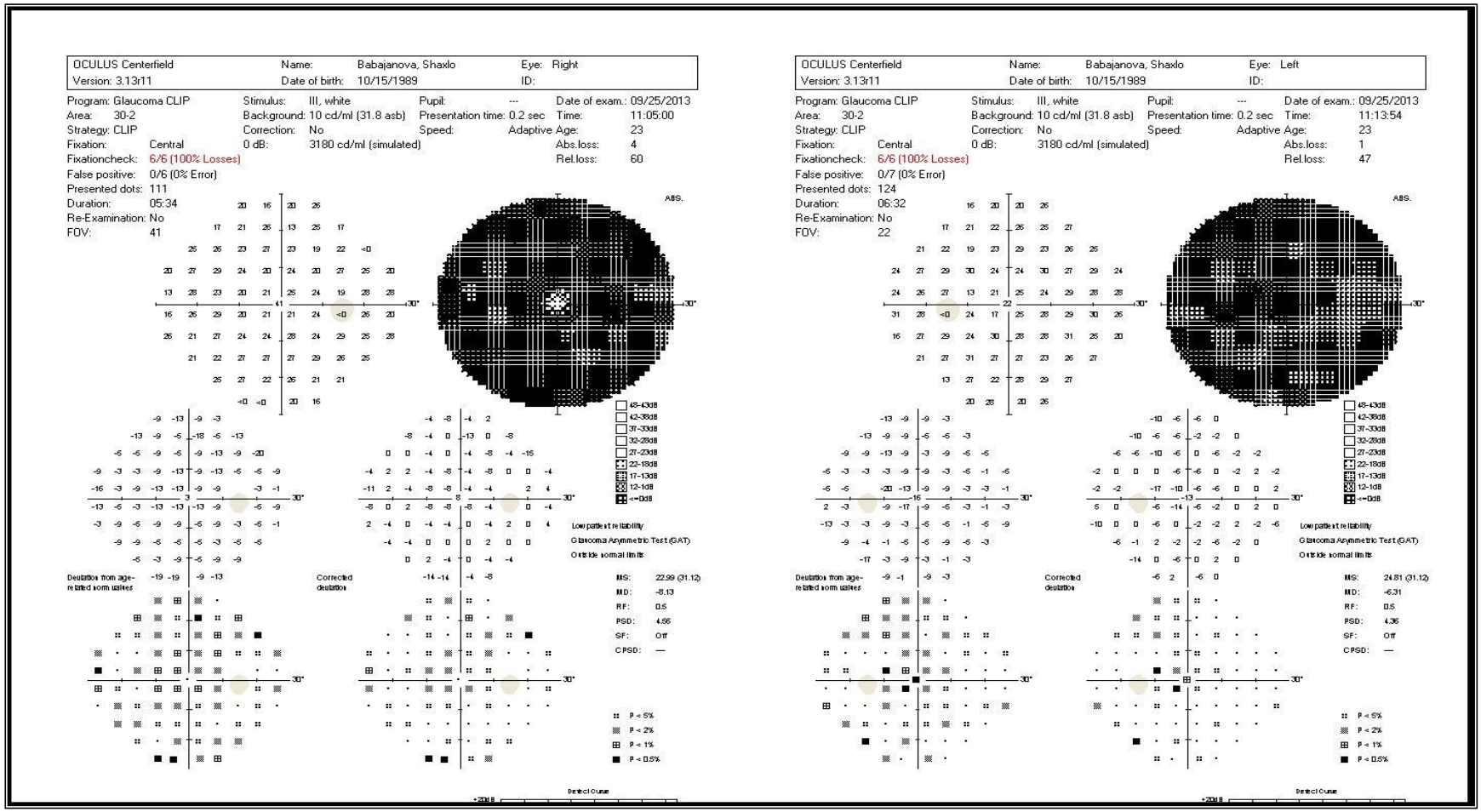


Fig.3.1. Patient B.Sh., 25 years old, diagnosed with stage III optic neuritis of both eyes. Study of the central visual field using the Humphrey 24-2 computer threshold program. A) right eye, b) left eye. Decreased light sensitivity was detected in both eyes. Visual acuity - 0.06/0.07.

Thus, the analysis of peripheral vision showed individual variability of FV defects, as well as statistically significant differences depending on the stage of OPTIC NEURITIS. Based on this analysis, it is possible to presumably determine the stage and localization of the process.

Condition of the anterior segment of the eye. Our studies have shown that in patients with OPTIC NEURITIS, no special deviations are observed from the anterior segment of the eye. Minor mixed injection of conjunctival vessels with mild corneal edema without an increase in intraocular pressure was observed in 4 cases (1.6%).

Condition of pupillary reactions. In 73 (73%) cases, the pupil was of average size (3 mm), in 5 (5%) - narrow, in 22 (22%) cases it was dilated to 5 mm. It should be noted that a wide pupil was observed mainly in patients of groups 3 and 4.

Direct and consensual pupillary reactions to light, as well as reactions to convergence and accommodation were studied. During examination, direct pupillary reaction to light was weak in 91 (91%) cases and completely absent in 9 (9%). Consensual pupillary reaction was preserved in 95 (95%) eyes and absent in 5 (5%). Pupillary reaction to convergence and accommodation was reduced in 39 (39%) eyes. Attention is drawn to the weakening of convergence in groups 3 and 4, where its violations amounted to 84% (30 of 38 eyes) and 81.8% (7 of 8 eyes), respectively, compared to groups 1 and 2, where the proportion of violations was statistically significantly ($p<0.05$) lower and amounted to 21 cases out of 55 observations.

Vitreous body condition. During the ultrasound examination, mainly in groups 2 and 3, prominence of the optic nerve head was noted, the contours of the retina in the optic nerve head area were uneven, and a cellular suspension was detected in the posterior part of the vitreous body. In group 4, a decrease in the echogenicity of the optic nerve head was observed (Table 3.5).

Table 3.5.

Results of B-scanning of eyes in patients with NON

Parameters	Groups							
	1(n=31)		2(n=31)		3(n=30)		4(n=8)	
	Abs	%	Abs	%	Abs	%	Abs	%
Prominenceoptic disc	11	33	11	33	11	33	0	0
Blurred retinal contours in the areaoptic disc	12	38	12	38	11	33	1	13
Cell suspension aboveoptic disc	5	18	5	18	5	18	2	26
Decreased echogenicity optic nerve	3	10	3	10	3	10	5	61

According to the results of **ophthalmodoplerography**, the anteroposterior size of the eyeball averaged 22.85±0.32 mm, the width of the eyeball was 23.15±0.41 mm, the anterior chamber was 2.83±0.14 mm, bulging of the optic disc was observed in groups 2 and 3, the retrobulbar part was 3.37±0.16 mm. At the same time, the peak systolic velocity in the central retinal artery (CRA) was reduced compared to the control group by 2.7 cm/s in group 1, by 1.9 cm/s in group 2, by 4.4 cm/s in group 3 and by 0.7 cm/s in group 4. The end diastolic velocity in the CRA was also low, with the exception of patients in group 1. The resistive and pulsatility indices in the CAC (RI) were within the normal range in groups 1-3, but in group 4 they increased by 0.13 and 0.35, respectively, compared to the control group (Table 3.6).

The peak systolic velocity in the CAC was also within the normal range in groups 1-3, and in group 4 it was increased by 3 cm/s. Also in group 4, the end diastolic velocity in the CAC was reduced by 2.2 cm/s. At the same time, the resistive and pulsatility indices in the CAC (RI) increased by 0.19 and 0.36, respectively, indicating a pronounced blood supply deficiency.

In group 4, a significant increase (by 16.2 cm/s) in the peak systolic velocity in the ophthalmic artery (OA) was noted, the end diastolic velocity, resistive and pulsatility indices in the OA in all groups were within the normal range. The ischemia coefficient was increased mainly in patients of the 4th group.

Consequently, in stage 4 of OPTIC NEURITIS, the diastolic velocity in the central retinal artery and the right cerebral artery, as well as the ischemia coefficient, decrease, and the resistive and pulsation indices in the central retinal artery and the right cerebral artery increase.

The condition of the fundus. According to our observations, the fundus picture in patients with OPTIC NEURITIS changed depending on the stage of the disease. Ophthalmoscopically, the hyperemia stage was observed in 31 (31%) eyes. In 74 (74%) cases, hyperemia of the optic nerve head was detected, while in 7 (7%) - temporal decolorization. In 76 (76.0%) cases, the borders were still preserved on one of the sides, more often the temporal one, edema along the optic nerve head vessels was visualized in 31 (31%), physiological excavation was absent in 88 (88%) cases. The number of vessels passing through the edge of the optic disc was increased to 16±2.3 in 82 (82%) eyes, in 86 (86%) eyes the veins were dilated, and in 69 (69%) the arteries were dilated (Fig. 3.2).

In group 2 (10 eyes, 30.7%) patients with the stage of optic disc swelling, the disc size was increased in 30 (91%) cases. Severe hyperemia of the optic disc was observed in 25 (78%) eyes, physiological excavation was absent in 32 (98.7%) eyes. The optic disc boundaries were completely blurred in 29 (89%) cases. Disc prominence of 1.5±0.2 diopters was observed in 28 (80%) eyes. The number of vessels passing through the edge of the optic disc increased from 18 to 26 in 24 (72.4%) cases, and the arteriovenous (A/B) ratio was 3:5 in 27 (81%) eyes. The retinal arteries were of normal caliber in 9 (3.3%) eyes, wide in 12 (47.4%), and constricted in 5 (19%) eyes. The veins were dilated in 6 (66%) eyes. Unilateral peripapillary edema was observed in 3 (10%) eyes, and severe peripapillary edema was observed in 27 (90.4%) eyes. Single hemorrhages were observed in 5 (52%) eyes. The macular reflex was preserved in 3 (11%) cases. Meanwhile, the reflex

was smoothed in 7 (75%) eyes, and macular edema was observed in 3 (11%) cases (Fig. 3.3).

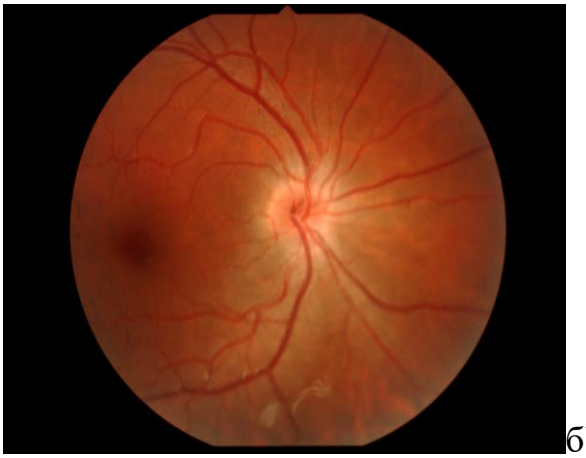
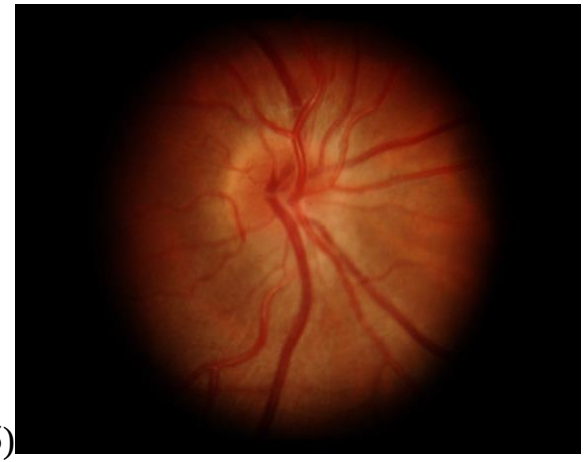
а)  б) 

Fig. 3.2. Fundus of the patient S.F., born in 1988. Diagnosis: right optic neuritis stage I. a) and b) optic nerve head is pink, borders are unclear, physiological excavation is slit-like, arteries are of normal caliber, veins are dilated, the number of vessels passing through the edge of the optic nerve head is increased, retina is without pathological changes.

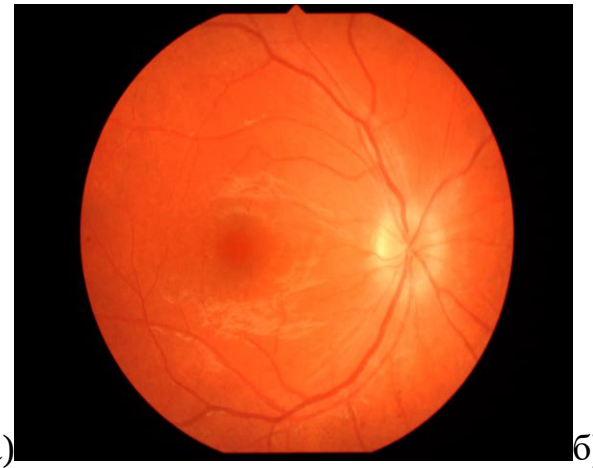
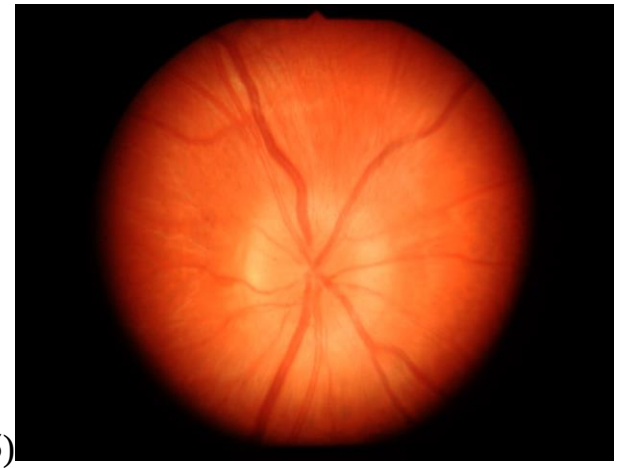
а)  б) 

Fig.3.3. Fundus of the patient A.S. diagnosed with NON, stage II. a) and b) in the fundus the optic disc is hyperemic, the borders are unclear, physiological excavation is absent, peripapillary edema is observed.

In group 3, in 16 cases out of 31 (51%, Fig.3.4) temporal decoloration of the optic disc was observed. At the same time, its protrusion was observed in 20 (65.7%) cases, in 28 (80%) cases the borders were unclear, physiological excavation was absent in 93% of cases. The veins were dilated in 20 (71.4%) eyes,

the arteries were dilated in 9 (27.1%), and in 18 (72.9%) they were narrowed. Single peripapillary hemorrhages were observed in 10 (14.3%) eyes.

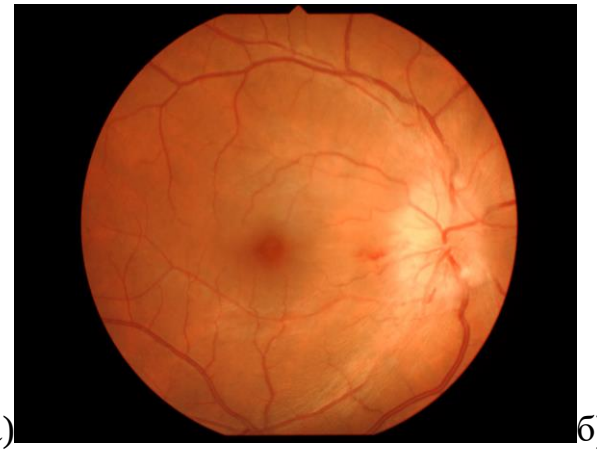
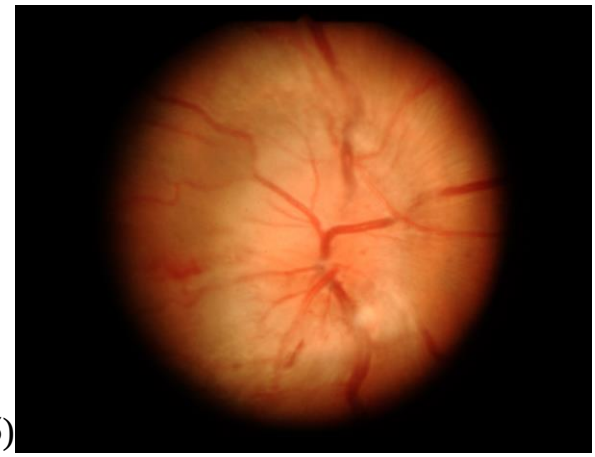
а)  б) 

Fig. 3.4. Fundus of the eye of patient M., born in 1999, diagnosed with stage III neuritis of the right optic nerve: a) and b) in the fundus, the optic nerve head is hyperemic, the boundaries are unclear, physiological excavation is absent, an increase in the number of vessels passing through the edge of the optic nerve head is observed, with changes on the part of the vessels in the form of a sharp narrowing of the arteries, pronounced edema of the optic nerve head and peripapillary zone is noted.

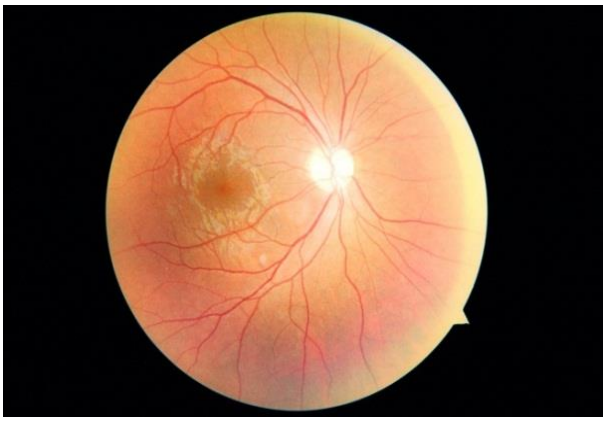


Fig. 3.5. Fundus of the patient Ya.A., born in 1976, diagnosed with stage IV right optic neuritis. The optic disc is pale, the borders are unclear, there is no physiological excavation, the vessels are narrow, the number of vessels passing through the edge of the optic disc is reduced.

In group 4, the optic disc was pale gray in 2 eyes (40.9%, Fig. 3.5), and was also pale in 3 eyes (50.9%), in 2 cases (25%) the borders were unclear due to the transition of glial tissue to the peripapillary zone of the retina, while physiological

excavation was absent in all cases. Arteries (2 eyes, 40.9%) and veins (4 eyes, 50%) were narrowed, the number of capillaries on the disc was reduced (4 eyes, 50%). The severity of optic nerve head edema was influenced by the age of the patients and the refraction of the eye. In children, all stages of the pathological process proceeded more quickly, and the severity of hyperemia and edema increased. In elderly patients, hyperemia was less pronounced, the ischemia stage quickly turned into optic nerve head atrophy. It should be noted that with farsightedness, the intensity of optic nerve head coloration was saturated, and with myopia, it was weakened. optic nerve head atrophy was often accompanied by clinical dissociations: in 2 eyes (20%), despite a decrease in visual acuity, there were no changes in the fundus, and vice versa. In 2 eyes (20%), despite clear signs of partial optic nerve head atrophy (optic nerve head pallor, decreased OCT and VEP indices), visual acuity remained high.

Thus, when analyzing the state of the optic nerve head and the retina, a significant difference in optic nerve head coloration, the level of edema, and the state of the vessels is noted, which correlate with the stage of the process. When examining the condition of the fellow eye, despite the absence of obvious changes in the main functional indicators of the eyes, with careful ophthalmoscopy, slight hyperemia of the optic nerve head compared to the norm, slight dilation of the arterioles and a change in the A/B ratio were observed, which dictates the need for close attention of ophthalmologists in the treatment of this category of patients.

Ophthalmoscopic studies are subjective, since doctors with different levels of training evaluate the same symptom differently. Distinguishing optic nerve head edema by stages is associated with certain difficulties, so there is a need to develop clear differential criteria for this symptom using objective diagnostic methods. For this purpose, we examined the morphological structure of the retina and the ONH using the OCT method and, based on it, developed quantitative differential diagnostic criteria for the stages of development of this pathology.

According to the data obtained, the average thickness of the retinal RNFL is significantly higher in patients of groups 2 and 3 compared to the control group (p

< 0.05). In patients of the 4th group, thinning of nerve fibers with a decrease in the thickness of the RNFL was revealed.

The conducted studies of measuring the thickness of the RNFL, NZ and the area of the optic nerve head in groups of patients with NON indicate that the indicators change depending on the stage of the disease. This allows using the OCT method for early diagnosis and monitoring of the pathological process in NON. Also, with the help of OCT, it is possible to promptly determine the spread of the inflammatory process from the third neuron to the second in NON, manifested by macular edema in stages II and III of the disease. Quantitative assessment of the state of the optic nerve head and retina in NON increases the reliability of the results obtained, which can be used to assess the effectiveness of neurotrophic therapy.

The OCT method allows identifying structural disorders, but for functional assessment, it is necessary to use it together with other studies, in particular with VEP and MR tractography.

3.2. Analysis of the results of the study of VEP at various stages of OPTIC NEURITIS

Many clinicians emphasize the importance of VEP studies for assessing damage to the visual pathway, providing information on the functional state of axons and the myelin sheath of the ON. At the same time, VEP recording allows tracing the conduction of a nerve impulse along the visual pathways, starting from the ganglion cells of the retina, through the optic tract and structures of the midbrain to the cerebral cortex [58, p. 21; 140, p. 121-128]. The reason for using VEP studies was the fact that this method is highly informative in cases where the patient does not have ophthalmoscopic changes in the fundus. VEP was performed in 53 patients (90 eyes) with various stages of ON. The first group with the stage of optic nerve head hyperemia consisted of 28 cases, the second with the stage of optic nerve head swelling - 21 cases, the third with the stage of ischemia - 26 cases, the fourth with the gliosis-atrophic stage of the disease - 15 cases. The

control group consisted of 10 somatically healthy individuals (10 eyes) of the same age category, not suffering from ophthalmopathology.

When assessing the shape of the P100 component, violations of the VEP configuration in the form of a split P100 component were revealed, and the W-like shape of the P100 peak reflected the presence of a central scotoma in the visual field or partial atrophy of the ON, which is confirmed by other researchers [133, pp. 847-850]. According to the results of the VEP for the checkerboard pattern, the N75 latency index in group 1 significantly increased compared to the control group (74.2±0.5 ms) and averaged 78.26±1.04 ms ($p<0.05$). The increase in latency indicated a decrease in the impulse conduction velocity along the visual pathways. A statistically significant increase in N75 latency was also noted in group 2 (81.64±2.09 ms) compared to the control ($p<0.05$). In group 3 of patients with stage optic nerve head ischemia, an increase in this index was noted (93.14±3.57 ms) compared to group 2 ($p<0.01$), although no reliable differences were found compared to group 4 (98.22±6.38 ms). The increase in latency is associated with a decrease in the velocity of potential conduction along the ON and indicates damage to the myelin sheath. Analysis of the state of the visual analyzer depending on the stage of the disease showed a significant increase in the latency of the P100 component with disease progression (Fig. 3.8). Almost all subjects showed an increase in the latent period of the P100 VEP from 10 to 30 ms compared to the upper limit of the normal values with chessboard pattern stimulation. In group 1 of patients, this indicator was 109.86 ± 2.11 ms, which is significantly higher compared to the control group ($p < 0.05$). At the stages of swelling and ischemia, this indicator tended to increase and averaged 112.73 ± 3.52 ms ($p < 0.05$) and 123.65 ± 3.93 ms ($p < 0.05$), respectively. An increase in latency was also recorded in group 4, by an average of 20-25%, where individual latency fluctuations were 118-135 ms, and the average value was 127.24±7.34 ($p<0.05$). When analyzing the N145 component indicator, we did not find any reliable differences between the main and control groups.

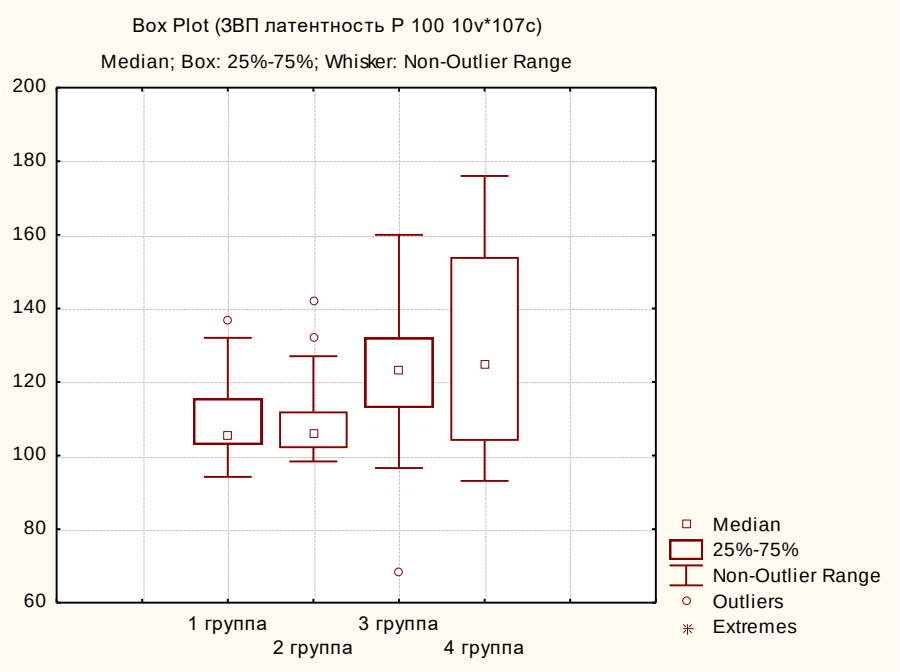


Fig. 3.8. Comparative analysis of VEP latency in 4 groups: median values, interquartile ranges, maximum and minimum P100 latency values.

The study also examined the parameters of VEP amplitude (Table 3.12). Analysis of the VEP amplitude of the N75-100 component revealed a significant increase in this indicator in groups 1 and 2 compared to the control group (Fig. 3.9). In group 1, the average level was 13.91 ± 0.79 μV ($p < 0.05$), in group 2 15.77 ± 1.29 μV ($p < 0.05$). In the acute phase of neuritis, ischemia, toxic effects of exudate, compression of nerve fibers by exudative fluid, and disintegration of the myelin sheath of nerve fibers occur. The increase in the VEP amplitude of the N75-100 component is apparently associated with reactive irritation of the ON axons by exudative reactions occurring in the ON membrane. The amplitude of the N75-100 VEP component significantly decreased in group 3 (6.76 ± 0.76 μV) compared to the control group ($p < 0.05$), as well as with group 2 ($p < 0.001$). The decrease in the VEP amplitude is associated with a blockade of impulse conduction, probably due to damage to the axial cylinders of axons. A decrease in amplitude indicated a decrease in the number of functioning axons. At the same time, a significant slowdown in the amplitude of the N75-100 component was observed in group 4 patients - at the stage of ONH atrophy (3.68 ± 0.4, $p < 0.05$).

The decrease in the VEP amplitude correlated with the decrease in visual functions, which in turn indicated the death of nerve fibers.

Our studies also revealed reliable changes in the P100-145 component depending on the stage of disease development. Analysis of the VEP amplitude revealed a reliable increase in this indicator in groups 1 and 2 compared to the control group. In group 1, its average level was 12.73 ± 1.06 μV ($p < 0.05$), in group 2 13.31 ± 0.94 μV ($p < 0.05$). The amplitude significantly decreased in group 3 compared to group 2 to 7.54 ± 0.83 μV ($p < 0.001$). However, no reliable difference was found compared to the control group ($p> 0.05$).

A significant slowdown in the amplitude of the P100-145 component was observed in group 4 patients with the stage of optic nerve head atrophy (3.67±0.66 μV) compared to the control ($p< 0.05$) and group 3 ($p< 0.01$).

Thus, the VEP method confirmed functional disorders of the optic nerve head: patients in all groups showed an increase in the latency of N75 and P100, indicating a violation of the conductivity of the visual pathways. The P100 indicator was the most informative in optic nerve head atrophy. Low information content of the N145 indicator was revealed in optic nerve head atrophy. Consequently, changes in VEP indicators at different stages of optic nerve head atrophy will allow more reliably dividing the disease into stages and correlating conservative therapy. The VEP method allows for a quantitative and qualitative assessment of the state of the visual analyzer in patients with various stages of OPTIC NEURITIS, and in combination with an on-line examination provides broad opportunities for the early diagnosis of OPTIC NEURITIS, and also allows for effective monitoring of this group of patients.Research methods were used to determine the localization of the pathological process.

3.3. Evaluation of the role of methods in IDON

3.3.1. Results of MRI of the brain in IDON

When diagnosing NON, there is often a discrepancy between subjective data and the state of the fundus. I am defined as an additional stage of NON

diagnostics, being an indispensable tool for differentiating brain matter, determining the etiological diagnosis, prognosis and treatment tactics.

Due to the similarity of the clinical pictures of the fundus in stages 1-2 and 3-4 of NON, the patients were divided into 2 groups: group 1 included patients with the stage of hyperemia and swelling of the optic nerve head (acute stage), group 2 - patients with the stage of ischemia and atrophy of the optic nerve head (stage of transition to atrophy of the optic nerve head). Instead of four groups, 2 groups were left, combining the data of groups 1 and 2 into group 1 (31 eyes), and groups 3 and 4 into group 2 (69 eyes). The control group consisted of 10 healthy individuals. In group 1, in 20 (56.7%) cases with the stage of hyperemia and edema of the optic nerve head, MRI showed expansion of the perineural space and an increase in the thickness of the retrobulbar part of the optic nerve head to 4.6±0.02 mm, as well as an increase in its signal (Fig. 3.10); in 12 (43.2%) cases, MRI revealed no signs of pathological changes. In the control group, the thickness of the retrobulbar part and perineural space of the optic nerve head averaged 3.7±0.04 mm.

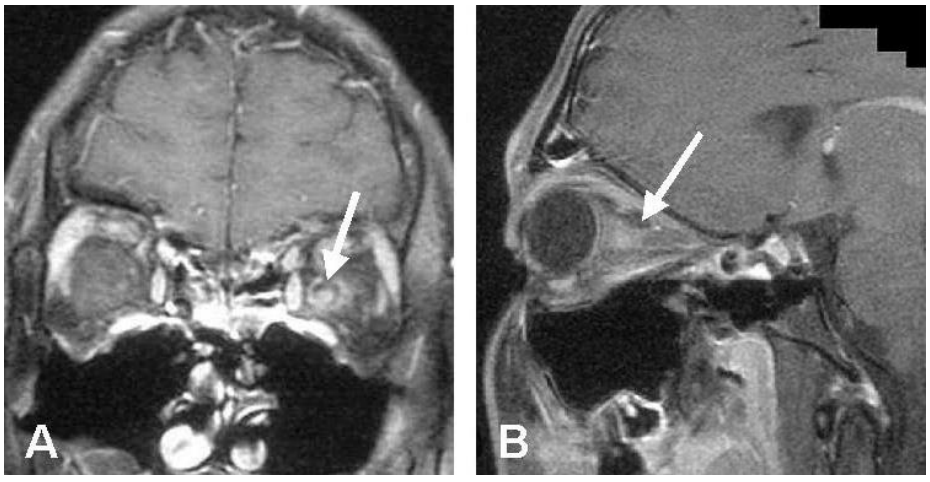


Fig. 3.10. MRI of the brain: increased signal from the affected optic nerve. A) coronal view, B) lateral view.

In group 2, in 15 (53.3%) cases with the stage of ischemia and atrophy of the optic nerve, MRI showed a decrease in the diameter of the perineural space and the

retrobulbar part of the optic nerve (2.8±0.12 mm), in 14 (46.7%) cases, no pathological changes were detected.

Inflammatory diseases of the paranasal sinuses were detected in 14.5% (3 patients) of cases. In sphenoiditis and pansinusitis, MRI showed bilateral lesions of the optic nerve (Fig. 3.11).

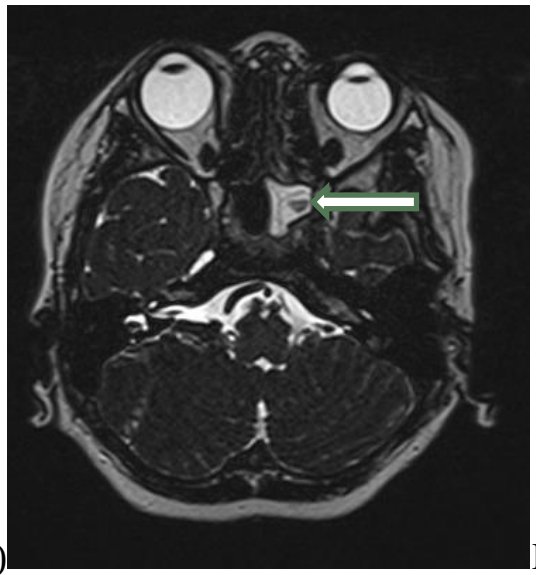
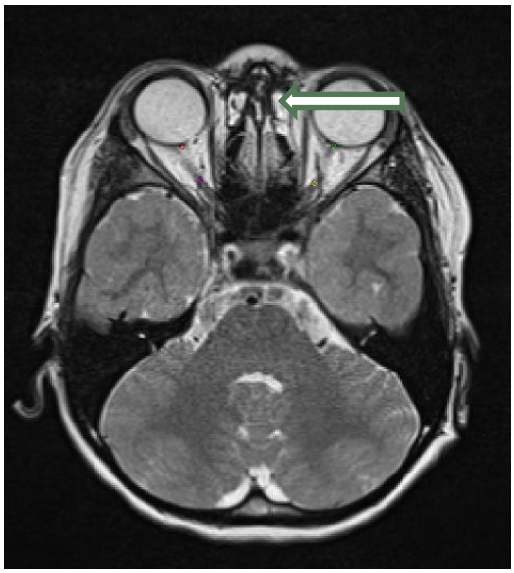
А)  Б) 

Fig. 3.11. MRI of the brain A) presence of mucosal hyperplasia in the sphenoid sinus B) presence of mucosal hyperplasia in the ethmoid sinuses.

According to the literature, the bony canal of the ON borders on the posterior cells of the ethmoid labyrinth or the main sinus, and the ON is separated from the mucous membrane of the paranasal sinuses only by a very thin bone wall. These anatomical relationships create favorable conditions for the transition of the inflammatory process from the paranasal sinuses to the ON [1, p. 36-37].

Of the examined patients, 2 (7%) had subcortical and periventricular foci in the white matter of the brain on MRI.

Thus, MRI of the brain is a highly informative method for neuritis of rhinosinusogenic etiology. However, difficulties arise in the absence of changes in the MRI of the brain, it is impossible to establish a connection between the state of the optic nerve head during ophthalmoscopy, the functions of the visual organ and the picture of the MRI of the brain. Many questions remain regarding the state of

the visual pathways and tract. All this was the basis for conducting functional research methods.

3.4. Results of laboratory research methods

One of the features of the course of inflammatory eye diseases is the state of general and local immunity. It is known that the cause of inflammatory eye diseases is often chronic or acute infections, which are characterized by shifts in almost all links of natural and adaptive immunity [25, 15-18]. Immune disorders can be both a prerequisite for the development and a consequence of the infectious process. In inflammatory eye diseases, there is stimulation of local and systemic production and imbalance of pro- and anti-inflammatory cytokines, defects in the interferon system (deficiency or, conversely, hyperproduction of IFN-α and/or IFN-γ), weakening of T-cell immunity, especially its helper link, disimmunoglobulinemia (in serum and tear fluid), an increase in the concentration of circulating immune complexes [37]. On the immunological examination map, the indicators in patients with inflammatory eye diseases were changed compared to healthy individuals (Table 3.15). The cellular link of immunity - CD3+ (total pool of T-lymphocytes) was reduced to 52.77±1.29% ($p<0.001$), CD4+ to 580.72±50.46 μl ($p<0.001$), CD4+ (T-helpers) -26.44±0.33% ($p<0.001$). CD8+ (T cytotoxic lymphocytes) was increased to 26.33±1.23% ($p<0.05$). The immunoregulation index was also reduced and amounted to 1.03±0.05 ($p<0.001$), the number of CD16+ (natural killers) increased to 22.88±0.85% ($p<0.001$). Humoral immunity: a decrease in Ig G was observed, 1091.61±29.66 ($p<0.05$), while Ig A was increased and amounted to 162.5±6.99 ($p<0.001$).

Table 3.15.

Immunological status of blood in patients with OPTIC NEURITIS

Indicator	Group 1(patients with IDON)	2-control group (healthy individuals)	P

Leukocytes	7666,66±643,51	6503,6±254,3	>0,05
Lymphocyte	2181,16±168,82	2126,3±89,6	>0,05
CD3 %	52,77±1,29	59,5±1,04	<0,001
CD3 mkl	1163,77±107,36	1256,0± 88,4	>0,05
CD4 %	26,44±0,33	36,7±0,46	<0,001
CD4 mkl	580,72±50,46	840,6±28,43	<0,001
CD8 %	26,33±1,23	23,5±1,16	<0,05
CD8 mkl	582,72±60,33	506±46,2	>0,05
IRI	1,03±0,05	1,75±0,04	<0,001
CD16 %	22,88±0,85	16,4±0,76	<0,001
CD20 %	21,44±0,30	22,8±0,28	>0,05
CD20 mkl	467,22±36,31	495±36,31	>0,05
IgG	1091,61±29,66	1178,4±17,5	<0,05
IgA	162,5±6,99	123,8±5,6	<0,001
IgM	120,94±5,63	136,6±4,2	>0,05

The main manifestations of immunopathology in patients with neuritis against the background of systemic diseases (16 patients) were expressed in the depression of the functional activity of T-lymphocytes, a decrease in the relative number of T8 killers - suppressors, a decrease in the absolute number of T-killers, an increase in the relative number of T-helpers, an increase in the CD4 + / CD8 + ratio, the presence of systemic autoantibodies: antinuclear and antiglobulin, hyperimmunoglobulinemia, and hyperconcentration of circulating immune complexes. The development of autoimmune reactions is associated with a weakening of the T-suppressor link and a change in the ratio of immunoregulatory subpopulations of T-cells. An indirect indicator of the autoimmune process was an increase in the CD4 / CD8 index (up to 2.0 and above), whereas in infectious neuritis this indicator was below normal (less than 1.0). When assessing the immunological status of patients with viral OPTIC NEURITIS, an imbalance of

immunoregulatory populations of T-lymphocytes, suppression of the immunoregulation index, an increase in killers, an increase in the apoptosis marker, as well as the presence of an inflammatory process on the mucous membranes of the body were observed. Thus, the state of general immunity in patients with viral OPTIC NEURITIS indicates a systemic nature of processes that can be divided into autoimmune, dyshormonal and suppressive. Depending on the nature of the state of immunity, it is necessary to correct the treatment regimens for this category of patients.

3.5. Evaluation of the informativeness of diagnostic methods with the development of an algorithm for diagnosing patients with IDON

Early diagnostics of optic nerve defects is of great importance for preventing or limiting structural damage to the optic nerve head and irreversible loss of visual function. However, the issue of diagnosing optic nerve defects at the subclinical stage still seems to be insufficiently studied; there is no clear algorithm for using modern high-tech research, both in early diagnostics and in disease monitoring. Modern methods of complex diagnostics provide maximum efficiency of patient screening and reliable detection of the disease at an early stage of development.

Despite the large number of methods, the emergence of new devices, often expensive, is of interest to ophthalmologists. However, to what extent these methods are justified for optic nerve defects and whether they should be introduced into diagnostic standards, diagnostic tests of the sensitivity of these methods for this pathology can answer these questions.

Among diagnostic tests, sensitivity and specificity indicators are widely used, characterizing the possibility of testing hypotheses about the presence or absence of a disease using a diagnostic method. Specificity is the probability of a negative result in a healthy person. This indicator characterizes the ability of this test to detect the absence of a disease. Whereas sensitivity is the probability of a positive result in a patient. This indicator characterizes the ability of this test to detect the disease. In this regard, the accuracy of modern diagnostic methods was

analyzed, the most sensitive methods were determined and, on their basis, a rational algorithm for early diagnostics of optic nephritis was formed.

A statistical analysis of the obtained research results was carried out, the sensitivity and specificity of each diagnostic method were determined for the method with the highest accuracy, the most significant parameters were determined. These parameters reflect the ability of the diagnostic method to detect the disease at an early stage and conduct differential diagnostics with other optic nephritis diseases.

The specificity and sensitivity of the following research methods were studied: anamnestic examination, ophthalmoscopy, static perimetry, OCT, VEP, MRI, MR - tractography. It follows from the table that collecting anamnesis from a patient with optic nephritis is a fairly effective diagnostic technique. It is known that optic nephritis is detected in young people, more often in the second and third decades of life, the development of the disease is accompanied by characteristic complaints of decreased visual acuity, the appearance of a spot in front of the eye, a feeling of rapid fatigue, pain behind the eye. A connection with concomitant diseases, in particular acute respiratory viral infections, influenza, and autoimmune diseases, has been noted. Even a properly collected anamnesis of the disease is quite valuable in diagnostic terms [19, pp. 170-174].

A fairly sensitive technique was the study of central FV on static perimetry, which in 84% of cases revealed a decrease in the threshold of light sensitivity, the presence of central and paracentral scotomas even with high OV and normal peripheral FV. It should be noted that the MD index was significantly lower in groups III and IV. The PSD index was also low in the corresponding groups. The sensitivity of static perimetry, i.e. the ability of this study to detect signs of the disease in patients with OPTIC NEURITIS, was 84%. The specificity of static perimetry, i.e. the proportion of healthy people who do not have such perimetric changes, was 82%. The most promising direction in the diagnostics of NTD remains the creation of a universal algorithm that combines high accuracy, simplicity and accessibility of the study. In this regard, we conducted a sensitivity

analysis of the most significant parameters in the early diagnostics of NTD, detected by OCT.

OCT allowed to detect the presence of ON pathology in the acute period of the disease in 90.1% of cases, which was manifested either by thickening of the peripapillary RNFL, respectively, with edema or pastosity of the optic nerve head, or by thinning of the RNFL in cases of chronic or subclinical ON. With the localization of the process remote from the optic nerve head, no changes in OCT indices were detected. Thus, the sensitivity was equal to 90.1%, and the specificity - 92%.

During the electrophysiological study, in patients with ON, in 92.9% of cases, a varying degree of increase in the latency of the P100 peak of VEP to patterns or a flash was detected, with a unilateral process, significant interocular asymmetry was determined. The latency of the P100 component tended to increase in all groups. An increase in latency indicated damage to the myelin sheath and a decrease in the velocity of potential conduction along the ON. Analysis of the VEP amplitude revealed an increase in this indicator in groups 1 and 2, the amplitude significantly decreased in group 3 compared to the control group, while a significant slowdown in the amplitude was more often observed in group 4 of patients. However, in 8% of cases of OPTIC NEURITIS, manifested by changes in the peripheral optic nerve, the VEP indices were within the normal range. Thus, the VEP method has a high sensitivity of 92.9% in detecting OPTIC NEURITIS, and a specificity of 84.2%. Using MRT, a decrease in the FA index in the ON was revealed in the group of patients with the stage of hyperemia and edema of the optic nerve head, while the ADC in these zones was increased inversely proportional to the coefficient. No statistically significant fluctuations in FA in the OL area were revealed. In the group of patients with the stage of ischemia and atrophy of the optic nerve head, a significant decrease in FA in the ON was revealed. An increase in the ADC index was also noted compared to the control group. A significant decrease in FA and an increase in MDC in the LC were

revealed in this group of patients. The specificity of the method was 76.4%, sensitivity - 82%.

Compared with traditional methods, the main differences and advantages of VEP, OCT and MRT are objectivity and the highest sensitivity in determining the stage of the disease.

Thus, static perimetry, OCT, VEP, MRI, MRT provide important additional information in detecting IDON. The comprehensive use of these research methods made it possible to identify OPTIC NEURITIS in 97% of cases, including subclinical forms of the disease. Table 3.17 shows changes in the main diagnostic parameters by disease stage.

Based on the results of clinical, instrumental and biochemical analysis, a diagnostic algorithm for examining patients with optic nerve head disease was developed, which allows for a correct clinical diagnosis and treatment direction:

1. Indications for including a patient in the study group are detection of a change in the color of the optic nerve head, blurring of the boundaries, narrowing or absence of physiological excavation, prominence of the optic nerve head, an increase in the number of vessels passing through the edge of the optic nerve head according to ophthalmoscopy.

2. Changes in perimetric parameters are an indication for static perimetry, color perimetry at the first stage of examination.

3. To assess the functional state of the visual system and to clarify the stage of the disease, the following are performed: OCT, VEP, MRI and MR tractography.

4. To clarify the etiology of the disease, laboratory tests are performed: general blood and urine tests, blood tests for TORCH infections, rheumatic tests, blood tests for brucellosis, syphilis, tuberculosis, borreliosis, LE cells.

5. To assess the immunological status of the body, prognosticate the course of the disease, immunological research methods are carried out: general immunogram.

The proposed algorithm allows to identify IDON, assess the degree of pathological changes in the ON and retina, determine the prognosis for the patient, which can be an important argument in justifying neuroprotective therapy, and will also avoid unjustified prescription of long and expensive studies and reduce the time spent on diagnostics (Appendix 1).

SUMMARY. Thus, in this chapter we have determined the different nature of the relationship between the structural and functional parameters of the ON and retina in patients with IDON. The data obtained indicate an insignificant lesion of the number of nerve fibers in stage 1 of the disease with a significant decrease in visual functions, which may suggest the onset of apoptotic processes in the ON and requires immediate therapy. An increase in the number of nerve fibers involved in the inflammatory process in stages 2 and 3 of the disease indicates a risk of generalization of the process and acceleration of neuronal death. The revealed changes in the form of thinning of the nerve fibers of the visual atrophy with a partial break in the nerve fibers allow us to assume that the inflammatory process during the transition to the atrophy stage affects not only the third neuron, but can be accompanied by damage to the fourth neuron (visual radiation), which requires a comprehensive approach to therapy. The proposed algorithm for diagnosing IDON, based on determining the parameters that have the greatest accuracy, will significantly speed up the detection time and, accordingly, increase the effectiveness of treatment of this disease.

CHAPTER IV. JUSTIFICATION OF COMPREHENSIVE TREATMENT OF PATIENTS WITH IDON

4.1. Development of principles of treatment of patients with IDON

Frequent recurrence of optic nerve disease and its outcome in the form of optic nerve head atrophy indicate the low efficiency of numerous treatment regimens used in ophthalmology. Most methods of treating optic nerve disease include: combating the inflammatory process; desensitization; detoxification measures; combating the infectious agent; improving blood supply and nutrition of the optic nerve, dehydration therapy.

According to the requirements of the "Standards of Diagnostics and Treatment in Ophthalmology" of the Ministry of Health of the Republic of Uzbekistan (2014), optic nerve disease therapy includes the use of disinfectants, antibacterial, mydriatic, local anesthetics, beta-blockers, GCS, NSAIDs, angioprotectors, antihistamines, diuretics, potassium preparations, biogenic stimulants, antiviral and antifungal drugs. The obtained prospective data on OCT, VEP, MRT indicate the need for a differential approach and early neuroprotection.

Based on clinical, functional and laboratory data, we optimized the treatment regimen for patients with IDON. The main difference from the standard treatment was a differentiated approach depending on the stage of the disease and early use of a neuroprotective drug, i.e. from the first day of the patient's admission to the hospital. The following treatment principles were proposed:

- differentiated approach by stage and etiology of the disease;
- general and local anti-inflammatory therapy;
- early neuroprotective therapy.

The proposed treatment regimen includes:

1. Etiological treatment: antiviral therapy, sanitation of foci of infection, treatment of the underlying disease: toxoplasmosis, tuberculosis, kidney disease, autoimmune processes.

2. Anti-inflammatory therapy - a) glucocorticosteroid therapy: dexamethasone, diprospan, methylprednisolone. The duration of therapy was

determined by the dynamics of the inflammatory process, while its intensity decreased as the severity of inflammation decreased and visual functions improved; b) non-steroidal anti-inflammatory drugs - ibuprofen, voltaren; c) antibiotic therapy - cefotaxime, ceftazidime.

3. Dehydration therapy - diacarb, mannitol.

4. Desensitizing therapy - diazolin, ketotifen.

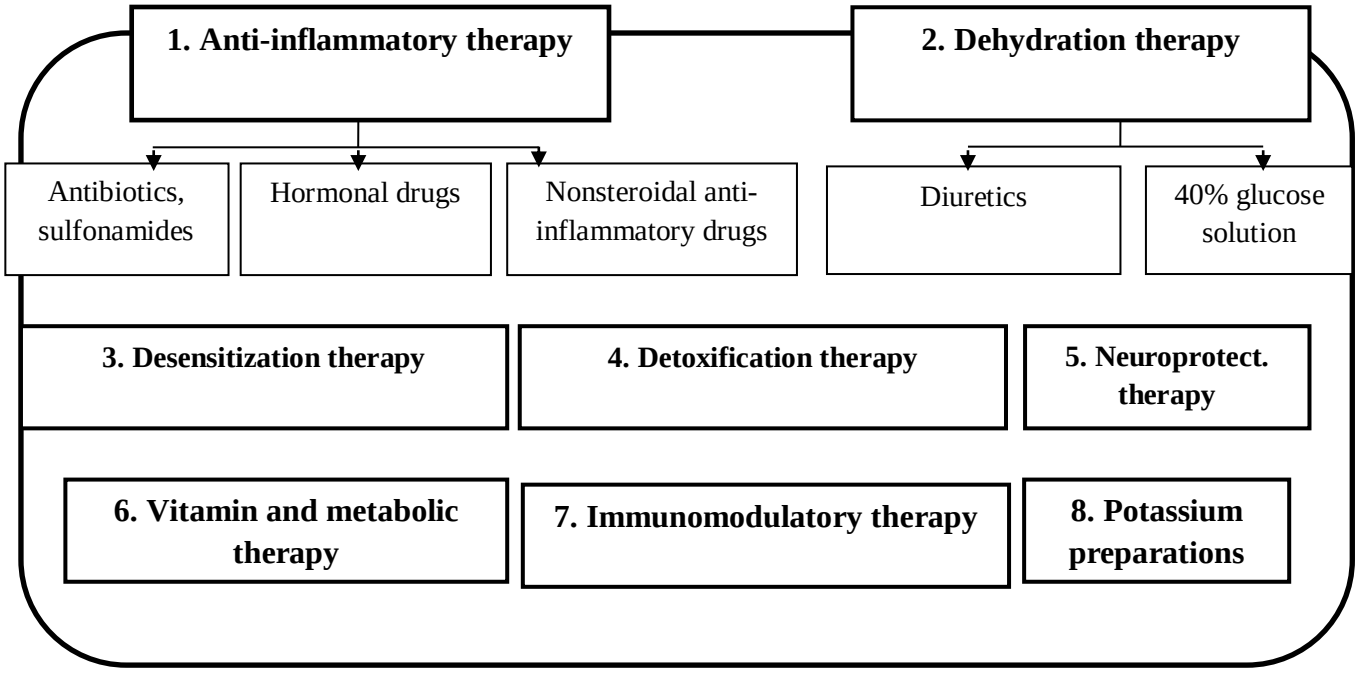
5. Detoxification therapy - reosorbilact, rheopolyglucin.

6. Potassium and magnesium preparations - panangin, asparkam, magnesium B6.

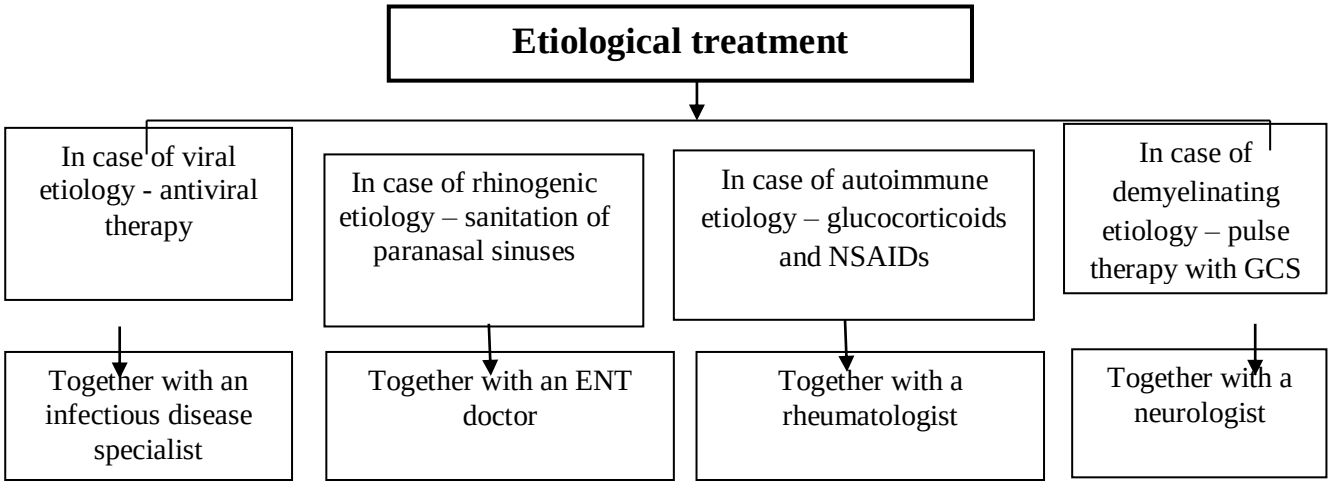
7. Neuroprotective therapy - cerebrolysin.

The indication for the use of neuroprotectors was a decrease in the amplitude of the VEP, a decrease in the RNFL index on OCT, thinning of the fibers of the occipital forceps in the projection of the connection with the optic radiation, signs of a partial break in the fibers at the site of attachment to the optic radiation bundle on MR tractography. Neuroprotective drugs, penetrating the blood-brain barrier, regulate intracellular metabolism and improve synaptic transmission. As a result of the introduction of these drugs, intracellular protein synthesis improves, the negative impact of lactic acidosis decreases. This effect in combination with stimulation of transsynaptic transmission provides a neuroprotective effect of the drug, that is, it increases the survival of neurons in conditions of hypoxia and other damaging effects. They also provide metabolic regulation, functional neuromodulation and neurotrophic activity [24, pp. 108-110]. Considering the close interrelations in the activity of the nervous and immune systems, the ability of specific neuro- and immunoregulators to induce and potentiate reactions, a promising direction in modern neuro-ophthalmology seems to be the use of drugs that simultaneously affect these systems. One of the drugs in this profile is Cerebrolysin, since it contains a combination of neuroactive amino acids, microelements and neuropeptides with neurotrophic and immunomodulatory properties. The neuropeptides included in Cerebrolysin, in addition to the neuroregulatory effect, have a pronounced immunomodulatory effect. Studies have

shown that Cerebrolysin significantly increases the level of CD 19+ and CD 4+ cells, enhances the expression of activation markers (HLA-DR, CD25) by lymphocytes and does not affect the expression of the CD95 molecule by them [25, pp. 15-18]. In this regard, we studied the effectiveness of using Cerebrolysin in patients with IDON.



In the case of clinical and laboratory confirmation of the etiology of the disease, treatment for acute OPTIC NEURITIS began with therapy for the etiological disease.



In 32% of cases (57 patients), the viral etiology of the disease was detected. In case of herpes infection, antiviral therapy was prescribed: acyclovir 200 mg 5 times a day orally for up to 10 days or 250 mg intravenously 2 times a day for 5-10 days, then 200 mg orally 2 times a day for 20 days. In case of cytomegalovirus infection, valacyclovir 500 mg 2 times a day for 10 days was prescribed (Table 4.1). Of the interferon inducers with an antiviral immunomodulatory effect, methylglucamine acridonacetate (cycloferon) was used, which is an early inducer of interferon types 1 and 2. The drug was administered intramuscularly at 250 mg once a day, the course duration was 10 doses, the basic course was carried out according to the scheme - 1, 2, 4, 6, 8, 11, 14, 17, 20 and 23 days [Egorov E.A. et al., 2004]. Patients with toxoplasmosis etiology (12 cases) were treated under the supervision of an infectious disease specialist. They received pyrimethamine 2 tablets per week for 6 weeks, cycloferon according to the scheme for 10 days, folic acid 1 tablet 3 times a day for 1 month.

Table 4.1.

Dosage of drugs and duration of treatment for IDON

Groups of drugs	**Preparations**	**Dosage**			**Course of treatment (days)**
		Locally (p/b)	**Systematically**		
			Dose	**Frequency (per day)**	
Locally (p/b)	Cefotaxime	0.5 ml	500 mg intramuscularly	2 times	7
	Cefotaxime	0.5 ml	500 mg intramuscularly	2 times	7
ГКС	Dexamethasone	0.5 ml	1 ml + physical solution 20 ml i.v.	2 times	5
	Diprospan	0.5 ml	-	1 time in 14	2

				days	
Antiviral	Acyclovir	-	250 mg + saline solution 200 ml intravenously, then	1 time	5
			orally 200 mg	3 times	20
	Valaciclovir	-	orally 500 mg	2 times	10
Interferonogens	Циклофе-рон	-	intramuscularly 2 ml	1 time	10
Desensitizing	Diazolin	-	orally 0.1 mg	1 time	10
Diuretics	Diacarb	-	orally 0.25 g	1 time	3-5
	Mannitol	-	IV 1 ml/kg	1 time	1-3
Potassium preparations	Panangin	-	1 tablet inside	3 times	10
Detoxification	Reosorbilact	-	intravenously 200 ml	1 time	3
	Infezol 100	-	intravenously 250 ml	1 time	3
NSAIDs	Ibuprofen	-	internally	2 times	5
Neuroprotective	Cerebrolysin	-	IV 10 ml + saline 10 ml	1 time	10
Vitamins	Into the complex	-	intramuscularly	1 time	10

In 26.4% (46 patients) of cases, diseases of the paranasal sinuses were detected. When focal infections such as ethmoiditis, sphenoiditis, sinusitis, tonsillitis, otitis were detected, antibacterial therapy was carried out with broad-spectrum antibiotics in the form of local and systemic injections. Patients were

consulted by an ENT doctor, paranasal sinuses were sanitized with the introduction of antibacterial drugs.

27% (27) of patients were admitted to the hospital after acute respiratory viral infections, influenza. Patients were prescribed antiviral drugs as part of complex therapy.

4.6% of patients (8) suffered from systemic diseases (rheumatism, rheumatoid arthritis), while long-term therapy with corticosteroids, NSAIDs and cytostatics was carried out under the supervision of a rheumatologist. In case of tuberculosis infection, anti-tuberculosis therapy was administered to 2 patients jointly and under active supervision of a phthisiatrician.

In 11 cases, inflammatory diseases of the brain were detected, such as optochiasmal leptomeningitis, meningoencephalitis. The patients were treated jointly with an infectious disease specialist and a neurologist. Kidney diseases, in particular pyelonephritis, were detected in 12 cases. The patients were consulted by a nephrologist. In 4 cases, OPTIC NEURITIS developed after uveitis, therefore, the patients were prescribed mydriatics, antibiotics and hormonal drugs subconjunctiva and parabulbar.

The following general somatic conditions were detected: pregnancy in 7 women and lactation in 16 women. The patients were prescribed only local anti-inflammatory and antibacterial therapy.

Rapid remission was achieved in patients with OPTIC NEURITIS, which arose as a result of the presence of focal infection foci in the body. Longer treatment of acute inflammation was required in patients with viral etiology, as well as in mixed etiology and systemic diseases. The etiopathogenetic focus of treatment of IDON is shown in Table 4.2.

Table 4.2.

Scheme of etiopathogenetic treatment of patients with IDON

Preparations	**Etiology**					
	Viral	**Rhino**	**Rheumat**	**Reproduct**	**Kidney**	**Mixed**

	inf.	**- sinusitis**	**oid diseases**	**ion of brain disease**	**disease**	**etiology**
GCS	*	+	+	+	+	*
Antibacterial	*	+	+	+	+	+
Antiviral	+	*	*	*	*	*
Diuretics	*	*	*	*	*	*
Desensitizing	+	+	+	+	+	+
Detoxification	+	+	+	+	+	+
Neuroprotective	+	+	+	+	+	+
Immunomodulatory	+	+	+	+	+	+
Vitamins	+	+	+	+	+	+
Potassium and magnesium supplement	*	*	*	*	*	*

Note: + - required, * - as indicated.

Thus, correctly selected antibacterial and antiviral therapy, as well as immunomodulatory therapy, contributed to a decrease in the likelihood of the formation of forms of diseases resistant to therapy, and a more rapid relief of acute inflammation, a reduction in treatment times and the number of relapses were achieved.

4.2. Results of complex treatment of OPTIC NEURITIS by stages of the disease

Depending on the stage of the disease, patients underwent complex treatment, with neuroprotective therapy prescribed from the first day of treatment. In the control group, patients received complex treatment without neuroprotective

therapy. The effectiveness of the treatment was assessed by visual function indicators (VA, FV), VEP, OCT, and MRT parameters.

The dynamics of visual acuity shows that as a result of the treatment, in the 1st group there was a reliable increase in VA after 10 days by 14.5%, after 1 month by 20%, and after 6 months by 24%, which is 1.7 times higher than the initial data (Table 4.3).

In the 2nd group, there was also an increase in VA after 10 days by 45%, after 1 month by 28%, and after 6 months by 35%. That is, this indicator increased 2.5 times from the initial data. In the 3rd group, the visual acuity increased by 46% on the 10th day of treatment, by 34% after 1 month, and by 30% after 6 months. Thus, in the 3rd group, the visual acuity after treatment increased by 2.5 times from the initial level. The dynamics of visual acuity in the 4th group reflects a gradual improvement, i.e. on the 10th day it was 0.09±0.015, after 1 month 0.17±0.03, and after 6 months 0.28±0.06, which is 4.5 times higher than the initial data. Consequently, early neuroprotective therapy in the complex treatment of patients with NDN significantly affected all stages of the disease. The large increase in visual acuity in the 2nd and 3rd groups is apparently explained by the fact that during the period of subsidence of the inflammatory process, some nerve fibers that were in a state of depression, but not affected by atrophic changes, are restored in patients.

Table 4.3.

Evaluation of treatment results based on visual acuity dynamics

Examination group (n-number of eyes)	**Average visual acuity (M±m)**			
	Before treatment	**In 10 days**	**1 month after treatment**	**6 months after treatment**
1-group (n = 31)	0,48±0,04	0,55±0,038	0,66±0,04*	0,82±0,02**°
2-group (n = 31)	0,29±0,04	0,42±0,04*	0,54±0,02*	0,73±0,06**°
3-group (n = 30)	0,24±0,03	0,35±0,035*	0,47±0,04*	0,61±0,04**°
4-group (n = 8)	0,06±0,01	0,09±0,015	0,17±0,03*	0,28±0,06**
Average OZ for four groups	0,25±0,01	0,35±0,032	0,46±0,03*	0,58±0,02**
Control group (n=18)	0,22±0,01	0,28±0,02	0,32±0,04*	0,45±0,02**

Note: * - differences relative to pre-treatment data are significant (* - P<0.01, ** - P<0.001); ° - differences relative to control group data are significant (° - P<0.01).

Thus, in the 1st group, there was a reliable increase in VA after 6 months by 1.7 times, in the 2nd group by 2.5 times, in the 3rd by 2.5 times, and by 4-4.5 times.

In the control group, before treatment, the VA indicator was 0.22±0.01. One month after treatment, the VA increased by 23% compared to the initial data. As a result of the complex treatment, a reliable increase in VA to 0.58±0.02 ($p<0.001$) was noted in the main group. This is 33% higher than the initial data and 13% higher than in the control group.

The dynamics of the SGFV indicators for white color in patients of the main groups after the complex treatment reflects an improvement: in the 1st group, the indicator increased by 25%, in the 2nd - by 49%, in the 3rd - by 37% and in the 4th - by 57%, which indicates the effectiveness of complex therapy (Table 4.4).

After treatment, the FV in the control group increased by 17%. It should be noted that in patients of the main group, the expansion of the FV boundaries, after a month of observation, is 63.140 more than in the control group, i.e. the indicator increased by 28% (120.88º) compared to the initial data.

In patients of the control group, a decrease in these indicators was noted 3 months after treatment, and in patients of the main group they remained, statistically significantly higher than the initial data, up to 6 months. The dynamics of the SGFV indicators for red color also improved: in the 1st group the indicator increased by 76.27º, in the 2nd - by 79.55º, in the 3rd - by 70º and in the 4th - by 58.8º. According to the results of computer perimetry after treatment, an increase in the average deviation of retinal light sensitivity was noted in the 1st group by 33.6%, in the 2nd - by 40%, in the 3rd - by 17.6%, in the 4th - by 18%.

Table4.4.

Survey group	MD (mean deviation of retinal sensitivity)			Total peripheral visual field boundary for white color			Total peripheral visual field limit for red color		
	Before treatment	**After treatment**	**R**	**Before treatment**	**One month after treatment**	**R**	**Before treatment**	**One month after treatment**	**R**
1-group (n =31)	-8,13±0,62	-5,04±0,12	0,01	363,3±14,12	456,7±13,9	0,0002	52,9±5,58	129,17±1,8	0,0001
2-group (n =31)	-11,88±0,89	-7,12±0,04	0,01	299,2±18,57	445,1±14,2	0,0001	43,15 ±4,75	122,7±2,3	0,0001
3-group (n =30)	-14,08±0,38	-11,6±0,13	0,04	316,1±16,48	432,7±4,12	0,0003	47,8±4,92	117,8±3,6	0,0001
4-group (n =8)	-22,16±0,14	-18,2±0,34	0,04	244,5±33,9	382,9±12,4	0,0074	37,7±8,4	96,5±4,4	0,0006
Average indicators for 4 groups	-14,1±0,51	-10,5±0,16	0,02	318,4±8,97	439,28±3,98	0,001	48,5±2,75	120,93±1,98	0,001

Контроль-ная группа (n =18)	-14,6±0,24	-12,3±0,24	0,06	318,4±8,97	439,28±3,98	0,001	48,5±2,75	120,93±1,98	0,001

Evaluation of treatment results based on visual field dynamics

Thus, with the complex treatment of optic nerve head, there is a reliable tendency to improve the optic nerve head and optic nerve head indices at all stages of the disease compared to the initial level.

Dynamics of ophthalmoscopic parameters. Ophthalmoscopic parameters of the fundus in group 1 after 1 month of treatment changed as follows: in 25 (79.7%) cases, the optic nerve head acquired a pale pink color, and in 3 (11.3%) it remained pale. Edema of the optic nerve head in 28 (88.7%) eyes completely resolved. In 22 (63.3%, $p<0.001$) cases, clear optic nerve head boundaries were ophthalmoscoped, while in 10 (34.2%), the optic nerve head boundaries remained blurred along the vessels and only in 2 cases (2.5%) were they completely blurred. Physiological excavation in 7 (9%, $p<0.001$) eyes acquired a normal volume (0.4-0.5 PD), in 3 (3.7%, $p<0.001$) eyes it remained slit-shaped (0.1-0.2 PD), and in 69 (87.2%, $p<0.05$) eyes it was absent. The number of vessels passing through the edge of the optic disc approached the norm in 66 (83.5%) cases. In group 2 of patients (31 eyes) with the stage of optic disc edema, after 1 month of treatment in 11 (42.1%) eyes, the optic disc acquired a pale pink color, while in 9 (31.6%) it remained slightly hyperemic. Edema of the optic disc completely resolved in 6 (22.4%) eyes, in 19 (61.8%) edema was visualized along the vessels. Physiological excavation was absent in 21 (71.1%) cases.

In 19 (63.3%) eyes, the optic nerve head boundaries were blurred only along the vessels, and in 4 (14.4%) they acquired a clear boundary. In 19 (59.2%) eyes, 14-17 vessels passed through the optic nerve head edge. Transition from stage 2 of the disease to stage 1 was observed in 31.6% of cases, and recovery was noted in 12 (42.1%) cases.

In group 3 patients (30 eyes), after treatment, the optic nerve head acquired a pale pink color in the fundus in 22 (68.6%) cases, and temporal decolorization of the optic nerve head was detected in 6 (20%) cases. In 15 (50%) eyes, the edema resolved, while in 12 (44.3%) cases, slight edema was observed along the vessels. Clear boundaries of the optic nerve head were detected in 16 (52.8%) eyes.

Thus, after complex treatment with the use of a neuroprotector, 21 (68.6%) eyes acquired an almost normal picture of the fundus, but due to the late treatment of patients in the hospital, temporal decoloration of the optic nerve head was observed in 7 (25.7%) cases.

In group 4 (8 eyes), the optic nerve head remained pale only on the temporal side in 2 cases. Physiological excavation was restored in 2 eyes. In 6 (81.8%) cases, clear boundaries of the optic nerve head were visualized, in 4 (50%) cases, the number of vessels passing through the edge of the optic nerve head approached the norm.

As a result of the analysis of the obtained data, it was found that early use of a neuroprotective drug in the complex treatment of IDON ensures stabilization of the studied parameters of the fundus and visual functions at all stages of OPTIC NEURITIS.

4.3. Analysis of the effectiveness of complex treatment based on OCT, VEP, and MR tractography data

Dynamics of OCT indicators. OCT examination of the fundus before treatment in groups 2 and 3 revealed edema of the disc and peripapillary zone, an increase in the thickness of the neuroretinal rim, and an increase in the thickness of the RNFL of the peripapillary zone. After complex treatment with early use of a neuroprotective drug, the dynamics of the RNFL indicator was positive for patients in group 2 with a high degree of reliability ($p < 0.05$). The thickness of the RNFL after treatment in group 1 decreased by 8%, in group 2 - by 37%, in group 3 - by 35%, and in group 4 - by 1.5%. When analyzing the thickness of the RNFL in four quadrants, patients in group 2 showed a reliable decrease in edema by 37% ($p < 0.05$) in the superior and by 52% ($p < 0.05$) in the temporal quadrants (Table 4.5, Figs. 4.1, 4.2). In group 3 patients, a decrease in RNFL edema by 44% ($p<0.05$) in the superior quadrant was observed. The thickness of the RNFL in the temporal,

inferior and nasal quadrants was also reduced, but the quantitative data were not statistically significant.

With regard to the area of the optic nerve head and optic nerve disc, a tendency towards a decrease in edema was observed in groups 2 (by 13% NP and by 10.5% optic nerve disc area) and 3 (by 20% NP), but these indicators were not statistically significant ($p>0.05$). In groups 1 and 4 after treatment, we did not observe significant changes in these indicators. The excavation volume in group 3 was restored ($p<0.05$). In general, as a result of the study of the effectiveness of complex treatment in patients with various stages of IDON, reliable ($p < 0.05$) positive dynamics of most of the studied parameters was established, mainly in patients with stages 2 and 3 of the disease. Thus, the earlier the inclusion of neuroprotection, the less thinning and atrophy of the optic nerve head, RNFL, the later the prescription, the lower the visual functions and more atrophic processes in the optic nerve head and macula.

Dynamics of VEP parameters. Analysis of the results of clinical studies showed that in all groups after the complex treatment, positive dynamics of electrophysiological parameters were noted.

The N75 latency indicator after treatment in group 1 decreased by 3%, in group 2 - by 22%, in group 3 - by 14% and in group 4 - by 24%. A decrease in latency indicates an improvement in impulse conduction in the myelin sheath of the ON (Table 4.6). When analyzing the dynamics of P100 latency depending on the stage of OPTIC NEURITIS, a decrease in its values to the norm was noted in patients of the 1st and 2nd groups, which amounted to an average of 104.8±1.56 ms and 109.1±4.62 ms, respectively.

Table 4.6.

Evaluation of treatment results based on the dynamics of VEP parameters

VEP Parameters		1 group		2 group		3 group		4 group	
		M±m	R	M±m	R	M±m	R	M±m	R
Lat N75	Before treatment	78,79±1,07	0,68	82,13±2,02	0,03	92,95±3,61	0,04	122,5±13,5	0,26
	After treatment	77,9±0,95		63,88±14,1		80,04±4,39		92,85±1,35	
Lat R100	Before treatment	109,8±2,11	0,22	112,82±3,51	0,63	123,5±3,91	0,51	162,5±1,5	0,10
	After treatment	104,6±1,56		109,08±4,62		118±5,15		128,5±8,5	
Lat N145	Before treatment	140,8±2,91	0,64	147,2±6,11	0,62	154,6±4,96	0,7	211,5±9,5	0,07
	After treatment	142,8±3,29		140,4±9,33		150,28		164±4,0	
Amplitude N75-P100	Before treatment	13,91±0,8	0,34	15,5±1,29	0,31	7,23±0,86	0,28	5,03±0,54	0,41
	After	15,59±1,45		12,47±2,1		9,2±1,03		6,09±0,41	

	treatment								
Amplit. P100-P145	Before treatment	12,73±1,06	0,89	13,1±0,93	0,04	7,35±0,75	0,12	5,07±0,31	0,33
	After treatment	12,43±1,2		17,14±1,75		10,1±1,7		6,13±0,4	

In patients of the 3rd and 4th groups, a decrease in P100 was also observed from 123.5±3.91 ms to 118±5.15 ms and from 162.5±1.5 ms to 128.5±8.5 ms, respectively, but due to ON ischemia, the P100 indicator did not return to normal. There was no statistically significant difference in the N145 indicators before and after treatment in the 1st, 2nd and 3rd groups. Despite this, a decrease in N145 latency was observed in all groups. The N145 indicator obtained in the 4th group was significantly lower than the same indicator obtained before treatment ($p<0.05$). The amplitude of the VEP component N75-100 one month after treatment increased by an average of 1.68 μV in the 1st (12%) and by 1.97 μV in the 3rd group (27%). In the 4th group, despite the transition to optic nerve head atrophy, an increase in the amplitudes of N75-100 by 21% was noted.

It should be noted that the P100-145 indicator increased by 4.04 μV in the 2nd ($p <0.05$) and by 2.48 μV ($p>0.05$) in the 3rd group. The increase in amplitude indicates the restoration of the functions of the ON axons.

Thus, for the first time, the restoration of the number of functioning axons in the treatment of stages I, II, III ON and a slight improvement in the conductivity of the ON in stage IV ON were shown.

Dynamics of MR tractography parameters. Depending on the type of treatment, 2 groups of patients were conditionally identified. The control group consisted of 10 patients (11 eyes) who received a standard course of treatment: anti-inflammatory, anti-edematous, desensitizing therapy. Patients in the main group (12 patients, 12 eyes), in addition to the above complex, received Cerebrolysin intravenously at 10.0 ml in 10 ml of physiological solution from the first day of treatment for 10 days.

CONCLUSIONS

The issues of diagnostics, treatment and rehabilitation of patients with optic neuritis are a serious medical and social problem. The absence of clear criteria for the course and recurrence of optic neuritis, involvement of the fellow eye in the process complicates timely diagnostics and pathogenetic treatment, which leads to low vision and blindness.

Conducting a comprehensive examination of patients with optic neuritis at the time of the first visit, clarifying the risk factors for the development of this disease, identifying the clinical features of the course, with an assessment of the results of ophthalmological, special and laboratory examination methods served as the basis for our work.

Given the relevance of the problem, the aim of the study is - based on the clinical and functional indicators of the eye, determining the features of the course and improving the principles of treatment of inflammatory diseases of the optic nerve, depending on the stage of the disease.

To achieve the goal, the following tasks were studied:

to establish clinical and functional criteria for optic neuritis (optic neuritis) depending on the stage of the disease;

to determine the diagnostic significance of methods (MRI and MR tractography) in optic neuritis; to study the effectiveness of complex treatment of optic nerve failure by stages of the disease based on clinical and functional indicators of the eye;

to develop a diagnostic algorithm and principles of treatment of patients with optic nerve failure.

The prospective study included 100 patients (118 eyes) diagnosed with optic nerve failure, observed at the Republican Clinical Hospital of the Russian Clinical Hospital from 2019 to 2021. The control group consisted of 20 people diagnosed as practically healthy.

According to the optic nerve failure classification [19], the patients were divided into 4 groups: Group 1 - 31 patients (31 eyes) at the stage of optic nerve

failure hyperemia; Group 2 - 60 patients (31 eyes) at the stage of optic nerve failure swelling; Group 3 - 15 patients (31 eyes) at the stage of ischemia: Group 4 - 21 patients (22 eyes) with the gliotic-atrophic stage of optic nerve failure.

Based on modern concepts of the neurophysiology of the visual pathway, we have developed a set of examination methods, including examinations by an ophthalmologist, ENT doctor, neurologist, infectious disease specialist, a study of the functional indicators of the visual organ, and, which made it possible to obtain an objective description of not only visual functions, but also to identify structural changes in the visual system.

As a result of the conducted study, when analyzing the age and gender data, it was revealed that OPTIC NEURITIS is more common in women, the majority of patients were aged 10 to 39 years (74.3%).

When analyzing the etiology of the disease, it was revealed that among the causes of OPTIC NEURITIS, viral diseases of the body (flu and colds, CMV, HSV) prevail - 48.2% and rhinosinusogenic diseases - 26.4%, while rheumatism makes up the smallest percentage. Most often, as a provoking factor, patients noted a previous acute respiratory viral infection - 96 (48.2%) within 2 weeks before the onset of the disease.

In a prospective analysis, patients with OPTIC NEURITIS of inflammatory etiology (100 patients, 118 eyes) mainly complained of impaired color perception (90 eyes, 90%) and decreased visual acuity (90 eyes, 90%). Along with this, a thorough survey revealed the presence of such complaints as: lack of object vision - in 8 cases (8%), pain when moving the eyeball and heaviness in the eye - in 18 (18%), the presence of a spot and / or fog in front of the eye - in 21 (21%) cases. Visual acuity (VA) indicators in patients with OPTIC NEURITIS varied significantly depending on the stage of the pathological process. In group 1, VA upon admission was 0.48 ± 0.04, in group 2 0.29 ± 0.04, in group 3 - 0.24 ± 0.03 and in group 4 - 0.06 ± 0.01. It should be noted that in group 2, VA above 0.1 was established in 59.2% of cases, of which above 0.7 in 14.5%. In the 3rd group, the visual field (VF) above 0.1 was approximately the same and amounted to 57.1%,

but it was above 0.7 only in 7% of cases. In the 4th group, eyes with very low vision (0.01-0.09) prevailed - 72.7%, and only 27.6% of them had VF above 0.1.

During perimetry, the total visual field (VF) boundary for white color along eight meridians in the 1st group was - 363.3±14.12º, in the 2nd group - 299.2±18.57º, in the 3rd - 316.1±16.48º, in the 4th - 244.5±33.9º. A much more sensitive technique turned out to be the study of VF for colors. In the 1st, 2nd and 3rd stages of the disease, inversion to red was noted: the boundaries of the visual field to red were significantly narrower than the boundaries to blue.

A fairly sensitive technique was the study of the central visual fields using computer perimetry, which revealed a decrease in the threshold of light sensitivity of the retina even with high OV and normal peripheral boundaries of the visual field. At the same time, as the disease progressed, the mean deviation of the retinal light sensitivity (MD) decreased and the pattern standard deviation (PSD) increased.

When studying pupillary reactions, the direct reaction of the pupils to light was sluggish in 91 (91%) eyes, the consensual reaction of the pupils was preserved in 94 (94%) eyes, the reaction of the pupils to convergence and accommodation was reduced in 39 (39%) eyes. That is, with NVN, the afferent part of the pupillary arc is affected, therefore, the study of pupillary reactions has significant diagnostic value in this pathology. Ultrasound examination revealed isolated opacities in the vitreous body mainly in groups 2 and 3 of patients, the contours of the retina in the area of the optic nerve head were also uneven in groups 2 and 3. In 83.7% of cases in group 2 and 83.1% in group 3, prominence of the optic nerve head into the vitreous body was noted, as well as a decrease in the echogenicity of the optic nerve head in 55.4% and 66.2% of cases, respectively.

During ophthalmoscopy of the fundus, hyperemia of the optic nerve head was characteristic of groups 1 and 2, and pallor of the optic nerve head was characteristic of groups 3 and 4. Edema of the optic nerve head was observed in groups 2 and 3, in all groups the boundaries of the optic nerve head were unclear, and physiological excavation was absent in most patients. Peripapillary edema of

the retina was observed in groups 2 and 3. Distinguishing optic nerve head edema by stages is associated with certain difficulties, so there is a need to develop clear differential criteria for this symptom using objective diagnostic methods. For this purpose, we examined the morphological structure of the retina and optic nerve head using OCT and, based on it, developed quantitative differential diagnostic criteria for the stages of development of this pathology. The results of the study showed high clinical effectiveness of using the OCT method in a comprehensive examination of the visual system and during dynamic observation of patients, including monitoring the effectiveness of therapy. The OCT method allows us to identify structural disorders, but for their functional assessment, it must be used in combination with other studies.

Among objective methods, the most sensitive is the study of VEP for a reverse checkerboard pattern. In our work, almost all examined patients of groups 1, 2, 3, 4 had an increase in the latent period of the N75 and P100 VEP components from 10 to 30 ms compared to the upper limit of normal values. At the same time, an increase in the N75-P100 amplitude was found in patients of groups 1 and 2, and a decrease in groups 3 and 4. In our work, we determined the different nature of the relationship between the structural and functional parameters of the ON and retina in patients with IDON. We, like foreign authors (Pueyo V. et al., 2009; Kolbe S. Et al., 2009), found a statistically significant correlation between the VEP and OCT parameters, as well as between VEP and VA. A close relationship was observed between the morphometric, electrophysiological and functional (OZ) parameters: changes in the NZ, RNFL were accompanied by a decrease in retinal photosensitivity, an increase in the MD and PSD indices, an increase in the latency of P100 and N75 and an increase in the amplitude of N75-P100 in the 1st and 2nd groups and a decrease in the 3rd and 4th groups.

In our work, for the first time studying patients with OPTIC NEURITIS of inflammatory etiology with stages of ischemia and atrophy, we found a decrease in FA in both the ON and VR, as a result of which we assume the spread of the neurodegenerative process to the 4th neuron with disease progression.

Compared with traditional methods, the main difference and advantage of VEP, OCT and MR tractography is objectivity and the highest sensitivity in determining the stage of the disease. The results of the study can be reduced to several numbers, which simplifies their analysis and further monitoring of treatment. Based on clinical, functional and laboratory data, we optimized the treatment regimen for patients with IDON. The main difference from the standard treatment was a differentiated approach depending on the stage of the disease and early use of a neuroprotective drug, i.e. from the first day of the patient's admission to the hospital. Having divided into 4 groups, the results of complex treatment were analyzed by stages of the disease. The dynamics of VA shows that as a result of the treatment in group 1, there was a reliable increase in VA by 34%, in group 2 by 44%, in group 3 by 37%, and in group 4 by 22%. In the control group, this indicator increased by 23%.

The dynamics of the FV index in patients reflects improvement: in group 1 the index increased by 25% ($p<0.001$), in group 2 – by 49% ($p<0.001$), in group 3 – by 37% ($p<0.001$) and in group 4 – by 57% ($p<0.001$). In the control group, this index increased by only 17%. According to the OCT results, the RNFL thickness after treatment in group 1 decreased by 8%, in group 2 – by 37%, in group 3 – by 35% and in group 4 – by 1.5%. When analyzing the RNFL thickness in four quadrants, patients in group 2 showed a reliable decrease in edema by 37% in the superior and 52% in the temporal quadrants. With regard to the area of the optic nerve head and optic nerve head, there was a tendency for swelling to decrease in groups 2 (by 13% of the optic nerve head and by 10.5% of the optic nerve head area) and 3 (by 20% of the optic nerve head). In groups 1 and 4, after treatment, we did not observe any significant changes in these indicators.

Analysis of the results of clinical studies showed that in all groups, after the complex treatment, positive dynamics of the VEP indicators were noted. The N75 latency indicator after treatment in group 1 decreased by 3%, in group 2 by 22%, in group 3 by 14%, and in group 4 by 24%. The decrease in latency indicates an improvement in impulse conduction in the myelin sheath of the optic nerve head

(Table 3). When analyzing the dynamics of P100 latency depending on the stage of the optic nerve head, a decrease in its values to the norm was noted in patients of groups 1 and 2. The amplitude of the VEP of the N75-100 component one month after the treatment increased by an average of 1.68 μV in the 1st (12%) and by 1.97 μV in the 3rd group (27%), in the 4th group an increase of 21% was noted. The increase in amplitude indicates the restoration of the functions of the ON axons.

Thus, for the first time, the restoration of the number of functioning axons in the treatment of stages I, II, III of the ON and a slight improvement in the conductivity of the ON in stage IV of the ON were shown.

According to the MR tractography data after the complex treatment in the main group, no pathological changes in the fibers of the conduction pathways were detected. In the control group, signs of partial rupture of the fibers of the greater occipital radiation in the area of attachment to the ON were detected. Thus, partial atrophy of the ON, which occurs with OPTIC NEURITIS, is a dynamic process, the treatment carried out removes a large number of nerve fibers from the state of parabiosis, as evidenced by the dynamics of visual acuity indicators, perimetry, VEP data, OCT and MR tractography. The obtained data in the form of improved visual functions, electrophysiological and OCT indicators, data and indicate the effectiveness and need for early neuroprotective therapy in the treatment of OPTIC NEURITIS. Based on the results of clinical, instrumental and biochemical analysis of the IDON, a diagnostic algorithm was developed that allows you to make a correct clinical diagnosis and helps determine the direction of treatment.

It has been established that the clinical and functional criteria of the ON condition depending on the stage of the ON are the data of CP, OCT and VEP. Namely, with CP there is a progressive decrease in MD and an increase in PSD; on OCT there is an increase in the thickness of the RNFL and NZ in groups 2 and 3, a decrease in these indicators in group 4; an increase in the latency index of P100 and a change in amplitude - according to the VEP data.

MRI of the brain makes it possible to conduct a differential diagnosis of the disease depending on the etiology and revealed sinusogenic and demyelinating

etiology. MR tractography revealed damage to the fourth neuron in the form of thinning and rupture of nerve fibers, a decrease in the FA indicator and an increase in the ADC, which indicates the spread of the neurodegenerative process in the ON from the 3rd neuron to the 4th neuron of the visual analyzer. 3. Early use of neuroprotective therapy in the complex treatment of optic nerve defects makes it possible to improve clinical, functional and objective indices in the fundus, which made it possible to achieve a positive result in 79.7% of cases in patients at the stage of optic nerve defect hyperemia, in 68.4% at the stage of swelling, in 50% at the stage of ischemia and in 13.6% of cases at the stage of optic nerve defect atrophy.

For differential diagnosis of various stages of optic nerve defects, a diagnostic algorithm has been developed, which includes static perimetry (sensitivity 84%), VEP and OCT (sensitivity 92.9% and 90.1%, respectively), as well as MRI of the brain and MRT (sensitivity 82%).

Pathogenetically oriented principles of treatment of patients with optic nerve defects have been defined, which include: a differentiated approach by stages of the disease, etiological and anti-inflammatory therapy, early neuroprotective therapy.

PRACTICAL RECOMMENDATIONS

1. Diagnostics of IDON should be based on an extended diagnostic algorithm, including visometry, color perimetry, pupillary response studies, ophthalmoscopy, VEP, OCT, MRI with tractography, as well as laboratory tests. An extended diagnostic algorithm for examining patients with IDON increases the efficiency of diagnostics of IDON stages and allows for targeted differentiated therapy.

2. We recommend implementing the MR tractography method to determine the prognosis of the disease.

3. It is advisable to measure the FA coefficient in the areas of interest using color and black-and-white FA maps to exclude areas of crossing pathways from falling into the selected area.

4. To achieve maximum and lasting clinical effect, we recommend early use and repeated courses of neurotrophic treatment every 6 months until visual functions stabilize.

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