Evaluation of the effect of osteopathic technique of drainage of venous sinuses of the skull on the structures of the posterior segment of the eye in patients with primary open-angle glaucoma

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INTRODUCTION

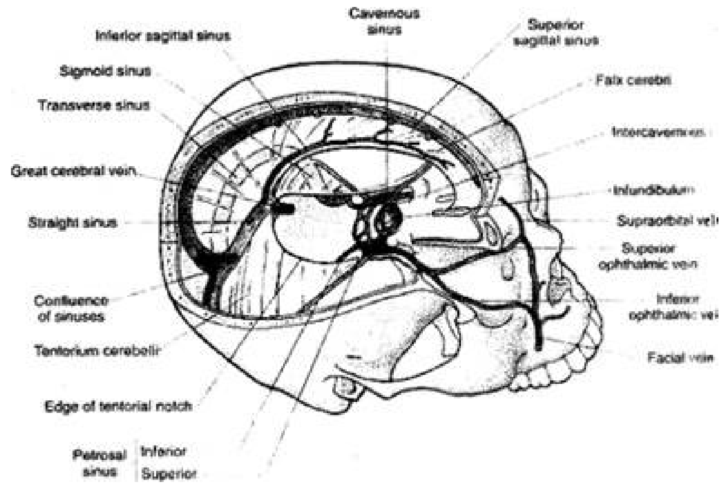
Until now, primary open-angle glaucoma (POAG) in all developed countries of the world remains one of the main causes of low vision, blindness and visual disability [5; 6].

Despite the achieved success in the treatment of glaucoma, this problem has not yet been resolved. It is known that it is much easier to achieve the normalization of ophthalmotonus than the stabilization of visual functions [2; 5]. According to V.F. Shmyreva and V.V. Shershneva (1997), traditional conservative therapy in more than half of glaucoma patients with normalized intraocular pressure (IOP) does not provide adequate blood supply to the optic nerve and prevent deterioration of visual functions. At the same time, drug therapy includes an ever-growing list of drugs that often have side effects, addictiveness, leading to various kinds of allergic reactions [Nesterov AP, 1995; Zimmerman TJ, Wheeler TM, 1982; Waller W. 1985; Croft MA et al. 1996; Pitch R. 1996; Maalouf T. 1996; Diggory P. et al, 1996].

Trying to find ways to solve this problem, namely to achieve stabilization of visual functions and, if possible, reduce the number of drugs used, we turned to the method of osteopathy. This method is aimed primarily at restoring the normal mobility of the craniosacral system, which improves the outflow of venous blood, eliminates venous stasis in the cranial cavity and has a normalizing effect on the circulation of cerebrospinal fluid (CSF) [10].

In our study, we stopped at the osteopathic technique of drainage of the venous sinuses of the skull for a reason. Its effectiveness is known in relation to the harmonization of cerebral hemo- and hydrodynamics [4; 7; ten; eleven]. We relied on the close anatomical and biomechanical relationship between cerebral and ocular hemo- and hydrodynamics.

As you know, the outflow of blood from all tissues of the orbit, including from the eyeball, is carried out by means of v. ophthalmica superior et inferior into the cavernous sinus, which is part of the sinus system of the dura mater (Fig. 1).



Rice. 1[1]... Connection of the veins of the orbit with the sinuses of the dura mater

In this case, the optic nerves can also be compared with a kind of hoses that connect the containers of the skull and eyeballs into a single hydrodynamic system. The tightness of the latter is ensured due to the fact that the outer sheath of the optic nerves (dura mater) is woven into the sclera on the one hand, and, on the other hand, passes directly into the dura mater of the brain [3]. Directly below the dura mater in the optic nerve, there is a slit-like space in which CSF circulates. The subdural space forms the so-called arachnoid sac of the optic nerve. It is similar to the arachnoid space in the brain.

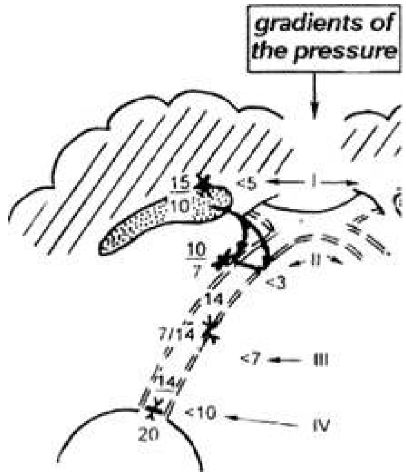
In the direction from the eyes to the brain, an axoplasmic flow of fluid constantly passes through the fibers of the optic nerves. In the opposite direction, the CSF is pumped into the subarachnoid space of the optic nerves by rhythmic contractions of the primary respiratory mechanism.

Overflow of the optic nerve with cerebrospinal fluid due to an increase in intracranial pressure (VID) is manifested, as is known, by a picture of stagnant optic nerve head (optic disc). A similar picture is inherent in a stagnant disc with a normal VIS, but with a significantly reduced ophthalmotonus. Thus, the relative prevalence of VIS over IOP adversely affects the lymph outflow from the optic disc and peripapillary region along the perivascular fissures through the ethmoid membrane. According to the same principle, the relationship between IOP and VIS develops, when the first rises against the norm or the second decreases: in both cases, the prerequisites are created for deflection of the ethmoid membrane from the eye cavity and the development of excavation of the optic nerve disc, in which compression of the optic nerve fibers occurs in the ethmoid plate of the sclera,

The found values of cerebrospinal fluid and tissue pressure in the optic nerve of various mammals turned out to be quite close to the level of their VIS. The latter, depending on the position of the body, ranges from 7 to 12 mm Hg. Art. [3]. But, what is very important, these indicators are 5-10 mm Hg. Art. below the true intraocular pressure, which is normally 8-21 mm Hg. Art., and on average is 16 mm Hg. Art. [Hollows F. et al., 1966].

Obviously, there is normally a gradient between IOP and optic nerve pressure. The structure that can withstand this constant load is the optic disc tissue and, first of all, the lattice membrane.

Pressure gradients exist at various sites in the brain - optic nerves - eyeballs system (Fig. 2).



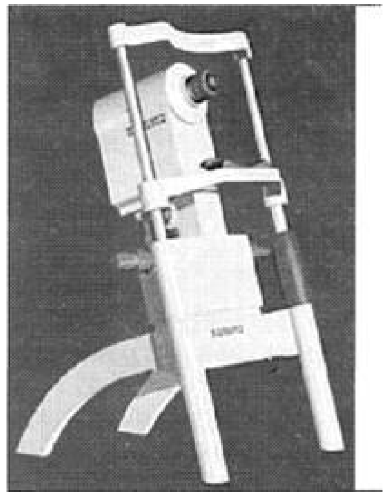
Rice. 2 [2]. Normal pressure gradients in the brain optic nerves - ocular
apples, where:
gradient I: tissue pressure of the brain - cerebrospinal fluid pressure in the ventricles of the brain; Gradient II: CSF pressure in the brain - CSF pressure in the optic nerves; gradient III: the difference between tissue and cerebrospinal fluid pressure in the optic nerve;
gradient IV: IOP - tissue-vital pressure in the optic nerve

Thus, the brain and eyeballs are connected by the optic nerves into a single hydrodynamic system.

In addition, as you know, CSF resorption is carried out by pachyon granulations (granulationes arachnoideales), through which CSF is drained into the venous sinus system of the skull. Thus, it can be concluded that ocular hydrodynamics is closely related to the venous circulation of the skull.

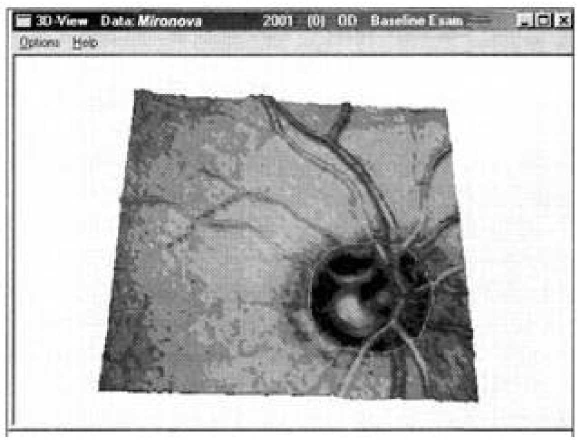
D. Brookes (1981) pointed out the possibility of osteopathic correction in patients with ophthalmic hypertension and glaucoma associated with obstruction of venous outflow from the cranial cavity. However, in the available literature, we were unable to find works that quantitatively assess the indicators of the state of the optic nerve head and retinal vessels in patients with glaucoma who underwent osteopathic correction. In addition, we were unable to find works that quantitatively assess the state of the posterior segment of the eye of patients after performing the osteopathic technique of drainage of the venous sinuses of the skull.

Currently, thanks to the intensive development of high technologies in modern medicine, in particular in ophthalmology, devices appear that allow high-precision diagnostics using computer technology. One of these devices is the HRT-II retinotomograph (Heidelberg Engineering, Germany), which is used for a comprehensive assessment of the state of the optic nerve head and the entire central retinal zone (Fig. 3).



Rice. 3. External view of the HRT-II retinotomograph

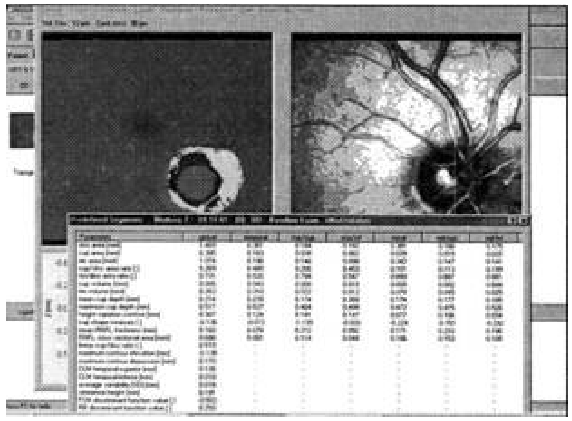
By the principle of operation, HRT-II is a confocal laser scanning system capable of capturing a three-dimensional image of the evaluated area of the fundus (Fig. 4).



Rice. 4. Three-dimensional image of the optic nerve disc obtained using HRT-II

The device makes it possible to quantify the parameters of the optic nerve head and dynamically monitor them. What is especially important - the results are evaluated in absolute terms with an accuracy of 0.001 mm [15].

The device allows you to evaluate the following stereometric parameters: the area and volume of the optic disc, the area and volume of the optic disc excavation, the area of the neuroretinal ring, the ratio between them, the average and maximum depth of the optic disc excavation, and others. A total of 22 parameters are assessed (Fig. 5).



Rice. 5. Automatic calculation of the optic nerve disc parameters as a whole (global column) and by sector

Summarizing the literature data, it should be noted that the smallest spontaneous variability among the estimated parameters during successive measurements with a short time interval between studies is characteristic of the optic disc rim area (rim area), average and maximum optic disc excavation depth (mean cup depth, maximum cup depth) [12 ; 13; fourteen].

In addition, using the available software HRT-II allows you to assess the caliber of the vessels in the fundus, which not only has diagnostic value, but can also serve as a criterion for evaluating the effectiveness of the treatment. Currently, a retinotomograph is one of the few devices that allows calibrometry of the fundus vessels on the basis of absolute values (with an accuracy of 0.003 mm) [1].

PURPOSE AND OBJECTIVES OF THE RESEARCH

The aim of the study is to quantify the effect of osteopathic drainage techniquevenous sinuses of the skull on the structure of the posterior segment of the eye in patients with POAG.

Research objectives

1. To evaluate in dynamics the quantitative indicators obtained using the retinal tomograph HRT-II, before and after the osteopathic technique of drainage of the venous sinuses of the skull in patients with POAG.
2. Compare the dynamics of the indicators obtained in the main and control groups.
3. To substantiate the necessity and expediency of using the osteopathic technique for drainage of the venous sinuses of the skull in patients with POAG.

MATERIAL AND METHODS

The work was carried out on the basis of the clinic of the Institute of Osteopathic Medicine of the St. Petersburg Medical Academy of Postgraduate Education, the Department of Ophthalmology of the St. Petersburg State Medical University named after I.P. Pavlova. The material summarizes the data obtained in the period from 2001 to 2004.

We formed two groups of patients (main and control), randomized by age and sex. The main group consisted of 7 women (14 eyes) with POAG at the age of 53-65 years, the control group - 8 women (16 eyes) with POAG at the age of 44-55 years. The fact that the study did not include male patients is explained by the random nature of the sample of patients who came to us and, possibly, by the fact that women are more responsible for their health. All patients had initial or advanced stages of glaucoma process in accordance with the classification of primary glaucoma adopted in Russia [6].

In all patients, IOP was normalized medically (0.5% timolol maleate) or surgically before inclusion in the study and averaged 17.6 mm Hg. Art, according to Goldman. The research algorithm was as follows: the patients of the main group underwent retinotomography with registration of the stereometric parameters of the posterior segment of the eye, then they underwent the osteopathic technique of drainage of the venous sinuses of the skull, and after that stereometric parameters were re-recorded using HRT-II. Patients in the control group underwent retinotomography, after which they had a 15-minute rest in the supine position, and retinotomography was repeated.

RESULTS

To objectify the results obtained, we were most interested in the indicators with the lowest spontaneous variability in successive measurements performed using HRT-II with a short time interval between studies. For clarity, the results of our work are summarized in table. 1.

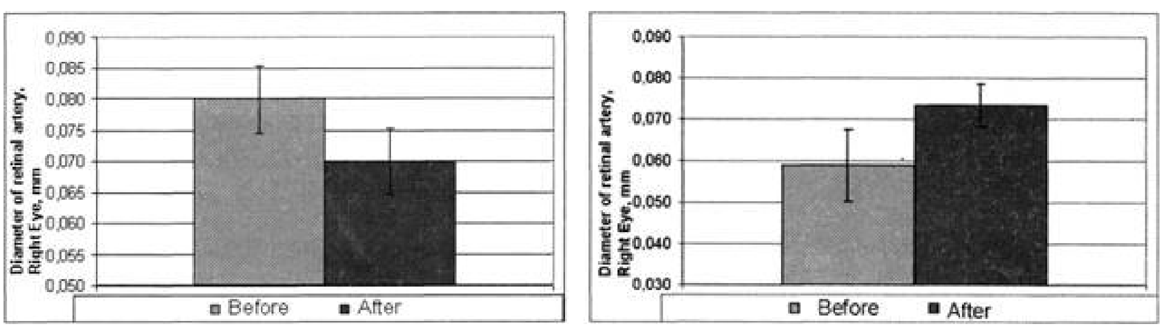
As you can see from the table. 1, in the main group, after the technique of drainage of the venous sinuses of the skull, there were statistically significant changes in the following indicators: mean depth of excavation of the optic disc OD (mean cup depth) ($p < 0.01$) with a tendency to increase in absolute values; maximum depth of excavation of the optic nerve disc OS (maximum cup depth) ($p < 0.05$) with a tendency to decrease in absolute values. Also, in this group, the diameter of the branches of the first-order CAS ($p < 0.05$ for OD, $p < 0.001$ for OS) changed statistically significantly (diagram in Fig. 6) with a tendency to harmonize the caliber of the named vessels in both eyes.

Table 1.

Dynamics of indicators

	average excavation depth, mm					
	OD			OS		
	n1	n2	R	n1	n2	R
main group, M ± m	0.471 ± 0.03	0.49 ± 0.02	0.002	0.48 ± 0.02	0.47 ± 0.07	0.264
control group, M ± m	0.297 ± 0.01	0.299 ± 0.01	0.215	0.261 ± 0.05	0.259 ± 0.05	0.418
	maximum excavation depth, mm					
	OD			OS		
	n1	n2	R	n1	n2	R
main group, M ± m	1.06 ± 0.038	1.05 ± 0.040	0.657	1.05 ± 0.018	1.03 ± 0.016	0.014
control group, M ±m	0.611 ± 0.05	0.614 ± 0.05	0.414	0.584 ± 0.05	0.584 ± 0.05	1,000
	diameter of the first order CAC branch, mm					
	OD			OS		
	n1	n2	R	n1	n2	R
main group, M ± m	0.080 ± 0.02	0.070 ± 0.02	0.049	0.059 ± 0.04 0.064 ± 0.02	0.073 ± 0.02	0.0001
control group, M ±m	0.071 ± 0.03	0.070 ± 0.03	0.138	0	0.068 ± 0.02	0.0001
	diameter of the first-order central water supply branch, mm					
	OD			OS		
	n1	n2	R	n1	n2	R
main group, M ±m	0.116 ± 0.006	0.125 ± 0.010	0.241	0.113 ± 0.005	0.116 ± 0.006	0.462
control group, M ±m	0.105 ± 0.003	0.106 ± 0.002	0.608	0.093 ± 0.003	0.095 ± 0.004	0.195

Note:
n1 - results of the first retinotomography; n2 - results of repeated retinotomography; p <0.05 (95% probability);
p <0.01 (99% probability);
p <0.001 (99.9% probability);
OD, right eye;
OS - left eye;
CAC - central artery retina;
CVS - Central Vienna retina.



Rice. 6. Dynamics of changes in the diameter of the branches of the CAS of the first order in female patients main group

Other indicators obtained using HRT-II were highly variable and had no statistical significance. However, when analyzing the diagrams of variability of characters for the diameter of the branches of the first-order PCV in the main group, there was a steady tendency to an increase in this indicator both in the right and left eyes (Fig. 7).

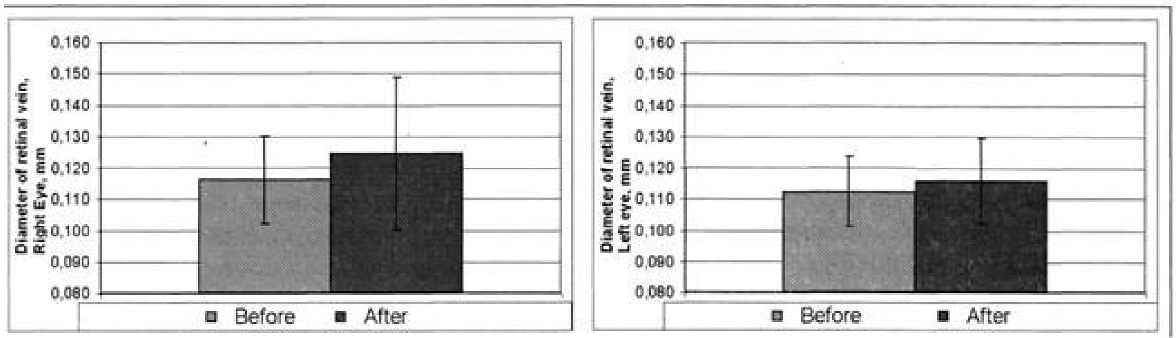


Fig. 7. Dynamics of changes in the diameter of the branches of the first-order PCV in female patients
main group

In the control group, we observed a statistically significant change in only one indicator - the diameter of the first-order CAC branch in the left eyes with a reliability of p <0.001.

DISCUSSION

The results obtained show that the technique of drainage of the venous sinuses of the skull not only has an effect on cerebral hemo- and CSF dynamics, as noted in their works by A.A. Skoromets et al. (2001), I.A. Egorova (2003), R. Caporossi, F. Peyralade (1992), VM Frymann (1998), but the hemo- and hydrodynamics of the eye also undergoes changes. At the same time, a slight increase in the average depth of excavation of the optic disc may indicate that the pressure gradient at the level of the lattice membrane of the sclera is changing (in favor of a decrease in the VIS). However, the relative decrease in the maximum depth of the optic disk excavation suggests that, nevertheless, the lattice membrane becomes more resistant to this pressure gradient. Perhaps this is due to an increase in perfusion pressure in the retinal vessels, which is indirectly confirmed by the harmonization of the caliber of the branches of the CAC and CBC, as well as the improvement of axoplasmic transport in the optic nerve fibers. To confirm this concept, further study of the changes occurring under the influence of osteopathic influence is required.

In the control group, no such changes were recorded. We attribute a slight increase in the caliber of the branches of the first-order CAC in this group to the orthostatic effects caused by patients resting in a horizontal position between studies.

CONCLUSIONS

1. After the technique of drainage of the venous sinuses of the skull in patients with POAG the average depth of the optic disc excavation (p <0.01), the maximum depth of the optic disc excavation (p <0.05) and the diameter of the branches of the central retinal artery of the first order (p <0.05 for OD, and p <0.001 for OS) significantly change, which can be associated with a change in the IOP / ICP coefficient and autonomic influences on arterial blood flow in the orbit.

2. In the control group, only the diameter of the branch of the central retinal arteries of the first order (p <0.001 for OS), which can be associated with a decrease in systemic blood pressure in the supine position.

3. Given the pathogenesis of glaucomatous neuropathy, the need for and the expediency of using the osteopathic technique of drainage of the venous sinuses of the skull in patients with POAG to harmonize the ratio of intraocular and intracranial pressure indicators, as well as to improve blood flow in the orbit, which will contribute to the decompression of optic nerve fibers in the ethmoid plate of the sclera,

an increase in retinal perfusion and a decrease in ischemic manifestations in the posterior segment of the eye.

CONCLUSION

1. Craniosacral osteopathy with POAG has a positive therapeutic effect, which is manifested in the improvement of regional hemodynamics in the basin of the central retinal artery, in the improvement of venous outflow in the basin of the central retinal vein, as well as in the harmonization of the pressure gradient at the level of the ethmoid membrane.

2. Obstruction of venous outflow from the cranial cavity is one of the factors, negatively affecting ocular hemo- and hydrodynamics, which has an unfavorable prognostic value in POAG.

3. The results of the studies carried out indicate the feasibility use of osteopathy in the complex treatment of patients with POAG.

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Assessment of the influence of osteopathic technique of venous sinus drainage on the structures of the posterior segment of the eye in patients with primary open-angle glaucoma. Vokhmyakov, I.A. Egorova, D.E. Mokhov, E.L. Akopov // Traditional medicine. - 2005. - No. 1 (4). - S.22-27.

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