

Eye

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Early Diagnosis of Ocular Hypertension Using a Low-Intensity Laser Irradiation Test.

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Abstract Objective: We investigated the potential use of low-intensity laser irradiation (LILI) as a diagnostic tool for identifying hypertensive eyes at risk of glaucoma. **Background data:** The diagnosis of early-stage ocular hypertension is particularly difficult to establish. **Methods:** This study of a case series included 123 healthy subjects with normal vision. The intraocular pressure (IOP) was determined before (baseline) and 30 min after a 30-sec irradiation of the limbus area with laser light (780 nm; 7.5 mW; 292 Hz modulation). **Results:** Baseline IOP was >21 mm Hg in 44 of 211 eyes (20.9%), consistent with ocular hypertension. LILI decreased the mean IOP by 6.2 mm Hg (-25.7%; $p < 0.001$; paired t test) in these eyes. The remaining 167 eyes (79.1%) exhibited a normotensive IOP ≤ 21 mm Hg. LILI reduced the mean IOP by 2.9 mm Hg (-17.1%; $p < 0.001$) in these eyes, but there were different response patterns: 1) the IOP did not change (27.0%); 2) the IOP was reduced by the same extent in both eyes (32.3%); 3) initial IOP differences between left and right eyes became level and the absolute IOP was reduced to a lower level that was identical in both eyes (18.0%); and 4) the initial difference in IOP between the left and right eye persisted despite LILI (22.7%). **Conclusion:** LILI lowers IOP, even in normotensive eyes. This effect may be useful to determine the individual physiological IOP and to diagnose latent ocular hypertension in eyes with presumably normotensive IOP.

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Low-level laser therapy improves vision in patients with age-related macular degeneration.

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Abstract Objective: The objective of this study of a case series was to examine the effects of low-level laser therapy (LLLT) in patients with age-related macular degeneration (AMD). **Background Data:** AMD affects a large proportion of the elderly population; current therapeutic options for AMD are limited, however. **Patients and Methods:** In total, 203 patients (90 men and 113 women; mean age 63.4 +/- 5.3 y) with beginning ("dry") or

advanced ("wet") forms of AMD (n = 348 eyes) were included in the study. One hundred ninety-three patients (mean age 64.6 +/- 4.3 y; n = 328 eyes) with cataracts (n = 182 eyes) or without cataracts (n = 146 eyes) were treated using LLLT four times (twice per week). A semiconductor laser diode (780 nm, 7.5 mW, 292 Hz, continuous emission) was used for transconjunctival irradiation of the macula for 40 sec (0.3 J/cm(2)) resulting in a total dose of 1.2 J/cm(2). Ten patients (n = 20 eyes) with AMD received mock treatment and served as controls. Visual acuity was measured at each visit. Data were analyzed retrospectively using a t-test. Results: LLLT significantly improved visual acuity (p < 0.00001 versus baseline) in 162/182 (95%) of eyes with cataracts and 142/146 (97%) of eyes without cataracts. The prevalence of metamorphopsia, scotoma, and dyschromatopsia was reduced. In patients with wet AMD, edema and bleeding improved. The improved vision was maintained for 3-36 mo after treatment. Visual acuity in the control group remained unchanged. No adverse effects were observed in those undergoing therapy. Conclusion: In patients with AMD, LLLT significantly improved visual acuity without adverse side effects and may thus help to prevent loss of vision.

[Vestn Oftalmol.](#) 2005 Mar-Apr;121(2):5-8.

[Progressing myopia in children: does it need treatment or not?]

[Article in Russian]

[Tarutta EP](#), [Iomdina EN](#), [Akhmedzhanova EV](#).

The purpose of the case study was to evaluate the remote consequences of a complex of laser and repeated surgical sclerorestorative procedures made in progressing myopia and its complications. Three hundred and forty-six children, aged 8-10, with rapidly progressing uncomplicated myopia of 4.25 to 9.5 D were shared between 2 groups. Two hundred and forty patients of the experimental group were made sclerorestorative procedures and transscleral low-energy laser stimulation of the ciliary muscle by means of infrared laser MACDEL-09. No such treatment was applied to patients of the control group. When indicated, preventive laser coagulation of the retina was made in both groups. The dynamic 10-year follow-up over the status of refraction and eye bottom showed that the complex scheme of repeated sclerorestorative procedures and low-energy laser treatment combined with preventive peripheral laser coagulation of the retina cut the rate of progressing myopia and prevented peripheral vitreoretinal dystrophy and retinal detachment in children and teenagers with progressing myopia.

Photobiomodulation Directly Benefits Primary Neurons Functionally Inactivated by Toxins

ROLE OF CYTOCHROME *c* OXIDASE*

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Far red and near infrared (NIR) light promotes wound healing, but the mechanism is poorly understood. Our previous studies using 670 nm light-emitting diode (LED) arrays suggest that cytochrome *c* oxidase, a photoacceptor in the NIR range, plays an important role in therapeutic photobiomodulation. If this is true, then an irreversible inhibitor of cytochrome *c* oxidase, potassium cyanide (KCN), should compete with LED and reduce its beneficial effects. This hypothesis was tested on primary cultured neurons. LED treatment partially restored enzyme activity blocked by 10–100 μ M KCN. It significantly reduced neuronal cell death induced by 300 μ M KCN from 83.6 to 43.5%. However, at 1–100 mM KCN, the protective effects of LED decreased, and neuronal deaths increased. LED significantly restored neuronal ATP content only at 10 μ M KCN but not at higher concentrations of KCN tested. Pretreatment with LED enhanced efficacy of LED during exposure to 10 or 100 μ M KCN but did not restore enzyme activity to control levels. In contrast, LED was able to completely reverse the detrimental effect of tetrodotoxin, which only *indirectly* down-regulated enzyme levels. Among the wavelengths tested (670, 728, 770, 830, and 880 nm), the most effective ones (830 nm, 670 nm) paralleled the NIR absorption spectrum of oxidized cytochrome *c* oxidase, whereas the least effective wavelength, 728 nm, did not. The results are consistent with our hypothesis that the mechanism of photobiomodulation involves the up-regulation of cytochrome *c* oxidase, leading to increased energy metabolism in neurons functionally inactivated by toxins.

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Therapeutic photobiomodulation for methanol-induced retinal toxicity

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Methanol intoxication produces toxic injury to the retina and optic nerve, resulting in blindness. The toxic metabolite in methanol intoxication is formic acid, a mitochondrial toxin known to inhibit the essential mitochondrial enzyme, cytochrome oxidase. Photobiomodulation by red to near-IR radiation has been demonstrated to enhance mitochondrial activity and promote cell survival *in vitro* by stimulation of cytochrome oxidase activity. The present studies were undertaken to test the hypothesis that exposure to monochromatic red radiation from light-emitting diode (LED) arrays would protect the retina against the toxic actions of methanol-derived formic acid in a rodent model of methanol toxicity. Using the electroretinogram as a sensitive indicator of retinal function, we demonstrated that three brief (2 min, 24 s) 670-nm LED treatments (4 J/cm²), delivered at 5, 25, and 50 h of methanol intoxication, attenuated the retinotoxic effects of methanol-derived formate. Our studies document a significant recovery of rod- and cone-mediated function in LED-treated, methanol-intoxicated rats. We further show that LED treatment protected the retina from the histopathologic changes induced by methanol-derived formate. These findings provide a link between the actions of monochromatic red to near-IR light on mitochondrial oxidative metabolism *in vitro* and retinoprotection *in vivo*. They also suggest that photobiomodulation may enhance recovery from retinal injury and other ocular diseases in which mitochondrial dysfunction is postulated to play a role.

Vestn Oftalmol. 2002 Mar-Apr;118(2):15-7.

Treatment of lacrimal duct diseases using low energy helium-neon laser

Dushin NV, Azibekian AB, Ali Akhsan M.

Treatment of diseases of the lacrimal duct remains a pressing problem in ophthalmology. These diseases are responsible for 71-85.4% diseases in capable people. Sixty patients with chronic dacryocystitis with partially retained patency of the lacrimal duct were treated by He-Ne low-frequency laser ULF-01 (output power 6.10 mcWt, laser beam wave length 0.632 nm).

The patients received 3-5 min sessions twice a week, 5-8 sessions per course. Positive effect was attained in 56 patients: complete cessation of excessive lacrimal discharge in 38 patients and subjective improvement in 18. He-Ne laser exposure brings about a good antiinflammatory effect; in combination with antibiotic therapy it promotes rapid sanitization of the lacrimal duct, removes edema, and rapidly normalizes lacrimal discharge.

Vestn Oftalmol. 2005 Jan-Feb;121(1):35-7.

[Quantum therapy and the composition of the moister of the eye anterior chamber (an experimental study)]

[Article in Russian]

[Pavliuk Elu](#), [Sherkhoeva DTs](#), [Pavliuk AIu](#), [Khristoforov VN](#).

We examined 12 rabbits, 6 of whom (12 eyes) were exposed to magneto-infrared laser radiation (MILR) and another 6 (12 eyes) were controls. The parameters of pulse and continuous infrared LED radiation were as follows: wavelength--860 nm, pulse capacity--2 W, mean radiation capacity--10 mW, magnetic field strength--up to 17 mTl. A study of the moister of the anterior chamber showed a MILR-induced activated metabolism, i.e. a better acid-base balance (ABB), more intense oxygenation in the ocular tissues and decreased acidosis. Higher concentrations of buffer bases (ABEe and SBEc) cause shifts in ABB towards metabolic alkalosis. A lower concentration of glucose denotes intensified processes related with its utilization. A lack of changes in the quantity of salts in the moister of the anterior chamber rules out the possibility of that the content of glucose would go down due to its dissolution with a big volume of newly produced moister. A lack of an increase in the concentration of whole protein, as observed after MILR, can be regarded as indirect evidence to absence of any adverse effect on the vascular wall.

Vestn Oftalmol. 2002 May-Jun;118(3):15-7.

[Laser magnetotherapy after cataract extraction with implantation of intraocular lens]

[Article in Russian]

[Maksimov VIu](#), [Zakharova NV](#), [Maksimova IS](#), [Golushkov GA](#), [Evseev SIu](#).

Effects of low-intensive laser and alternating magnetic field on the course of the postoperative period were studied in patients with exudative reaction after extracapsular cataract extraction with implantation of intraocular lens (IOL). The results are analyzed for 148 eyes with early exudative reaction after IOL implantation (136 patients aged 42-75 years). The patients were observed for up to 6 months. The treatment efficiency was evaluated by the clinical picture of inflammatory reaction, visual acuity, and results of biochemical analysis of the lacrimal fluid (the ratio of lipid peroxidation products to antioxidants in cell membrane). The course of the postoperative period was more benign and recovery sooner in patients of the main group in comparison with the control.

Vestn Oftalmol. 1997 Nov-Dec;113(6):17-9.

[New method of atherosclerotic macular dystrophies treatment]

[Article in Russian]

Basinskii SN, Krasnogorskaia VN.

The authors analyze the results of treating atherosclerotic maculodystrophies by direct laser phoresis. The method consists in insertion of a collagen infusion system in Tenon's space. Drugs (nicotinic acid or xanthinol nicotinate) are delivered to the posterior compartment of the eye through this system. Then a light guide is inserted in the tube and a 2-min session of low-intensity He-Ne laser exposure is performed at a wavelength of 630 nm, and 10 mWt/cm² flow power density (7 to 10 sessions per course). Clinical studies showed that vision acuity increased by an average of 0.08 diopters, or by 40% of the initial level, in 72% of cases. The peripheral visual field extended by an average of 51.4 degrees for 8 meridians in 95% of patients. The index of critical frequency of flashings fusing and the frequency-contrast characteristics improved in 85% of cases. The rheography improved by 34.5% of the initial level. A stable improvement was observed for 12 months after a course of direct laser phoresis in 97.5% of patients. Hence, the new method is simple and recommended for the treatment of atherosclerotic maculodystrophies.

Vestn Oftalmol. 2004 Nov-Dec;120(6):5-8.

[Dependence of the efficiency of low-intensity laser therapy in involution chorioretinal dystrophy on a used wavelength]

[Article in Russian]

Abramov MV, Egorov EA.

Seventy-five patients (75 eyes) with central involution chorioretinal dystrophy (non-exudative type at the progression stage) were followed up. All of them received low-

intensity laser therapy. Irradiation of 890 nm, 644 nm and 500 nm was used in groups 1, 2 and 3, respectively. The study purpose was to compare the efficiency of wavelengths. Visual acuity and retinal sensitivity were determined. The results were evaluated immediately after treatment and in 3 months. The maximal improvement in visual acuity and retinal sensitivity was in those who received 890 nm laser therapy; 500 nm irradiation--a less pronounced effect and 640 nm--the lowest one. We attribute such distribution of efficiency to a proliferation type of each irradiation range in the macular zone.

Vestn Oftalmol. 1996 Apr-Jun;112(2):25-6.

[Laser puncture combined with drug therapy in the treatment of primary corneal stromal dystrophy]

[Article in Russian]

[Maichuk IuF](#), [Orlovskaja LE](#), [Mal'-Alla DR](#).

A protocol of multiple-modality treatment has been developed, making use of laser puncture by stimulating infrared laser and drugs-aqueous 4% taufon and polygluquine taufon and artificial tears. The treatment proved to be highly effective: vision acuity stabilized, lacrimal production increased, and erosive cornea epithelialized.

[Lasers Med Sci](#). 2008 Jan 29 [Epub ahead of print]

Experimental study on low pulse energy processing with femtosecond lasers for glaucoma treatment.

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The feasibility of low energy processing in ocular tissues with femtosecond laser sources was investigated in this research. One laser source was a femtosecond amplifier, and the other was a femtosecond oscillator. The amplifier used in this experiment was a CPA-2001 (Clark-MXR, Inc), with 150 fs pulse duration and 1 kHz repetition rate. The femtosecond oscillator (model 900-B Mira) produced a 200 fs pulse duration and a 76 MHz repetition rate. Both these two laser systems operated at 800 nm wavelengths. Firstly, the pulse intensity thresholds in water produced by the two laser sources were compared. The optical breakdown probability analysis shows that the pulse energy threshold achieved by the oscillator was less than 10% of that achieved by the amplifier. Then, the non-linear propagation of the femtosecond pulses in the ocular tissues was studied with the femtosecond oscillator. The results showed a potential for pulse energy processing at the nanojoule level with a femtosecond oscillator in glaucoma treatment.

The comparative analysis of using lowpower laser radiation, magnetic therapy and electrical stimulation in stabilization of visual functions in primary open-angle glaucoma.

Listopadove N A et al.

127 men with a primary open-angle glaucoma(POAG) were treated with either L/LT, magnetic therapy or electrical stimulation. The examination included visus, visocontrastometry and automatic static perimetry. The field of sight at an initial stage of POAG was 56% of laser, 52 for magnetic therapy and 27 for electrical stimulation. In the advanced stage the figures were 39, 37 and 18, respectively.

Vestn Oftalmol. 1998 Nov-Dec;114(6):6-9.

[Heparin inhalations and laser exposure of blood in treatment of patients with open-angle glaucoma]

[Article in Russian]

Balashova LM, Listopadova NA, Zaitseva NS, Teplinaskaia LE, Efimov VS, Grishin VL, Kantarzhi EP.

Comparative assessment of methods aimed at amelioration of the immunohemostatic processes in patients with open-angle glaucoma suffering from chronic vascular diseases showed that the most remarkable improvement of the visual functions and decrease of the level of circulating immune complexes in the blood were attained in the patients treated by heparin inhalations combined with intravenous laser exposure of the blood as against patients treated by one of these methods alone or traditionally.

**Treatment of myopia with helium-neon laser stimulation.
Rabadanova M G et al.**

A new technique of stimulating the ciliary muscle in cases of progressing myopia is described. The positive results have been confirmed through measurement of the intraocular pressure, refraction reduction and increase of visual acuity.

Vestnik oftalmologii. 1999;115 5): 20-21.

[The treatment of posttraumatic uveitis with low-intensity laser Radiation].

Inkova G A, Ionin A P, Ionina G I.

Eighty-two patients with severe posttraumatic uveitis (eye inflammation) which could not be treated by traditional antiinflammatory therapy were exposed to LLLT. The patients were divided into 3 groups: - infrared laser exposure semiconductor pulsed laser, - intravenous exposure of the blood to a He-Ne laser and - both treatments. The treatment efficacy was monitored by measuring lipid peroxides and superoxide dismutase in the lacrimal fluid. The treatment proved to be effective. The best results were attained by applying both methods of exposure, as was shown by sooner normalization of the content of lipid peroxidation products and activity of superoxide dismutase.

Vestn Oftalmol. 2001 May-Jun;117(3):29-31.

[Ultraviolet irradiation of blood in combined treatment of traumatic endophthalmitis]

[Article in Russian]

Aznabaev MT, Babushkin AE, Karabanova IV.

Thirty-five patients (35 eyes) with traumatic endophthalmitis were treated. Ultraviolet exposure of autoblood was used in 16 patients, the rest 19 were treated routinely (antibiotics, etc.). Use of ultraviolet exposure of the blood in combined therapy of traumatic endophthalmitis more rapidly (12.6 vs. 22.1 days) and effectively (93.7 vs. 68.4%) arrested intraocular infection and more often preserved the objective vision (31.3 vs. 10.5%).

Vestn-Oftalmol. 1996; 112 (1): 31-32

[Effects of low-intensity infrared laser irradiation on the eye An experimental study].

Prokofeva G L, Kravchenko E V, Mozherenkov-V P.

Prokofeva evaluated the doses of infrared laser exposure for the structures of the eye in rabbit experiments, and the potentials of such lasers in ophthalmology were assessed. Wavelength was 890 nm and doses varied from 0.0001 to 1.0 J/cm², corresponding to exposure duration of 0.3 to 45 min. Experiments were carried out on 20 animals. The right eyes were exposed, and the left ones were control. An increase of intraocular pressure was recorded at a dose of 0.1 J /cm² (4.5 min) and higher. Morphological examination showed dilated, well filled and newly formed vessels in the ciliary body and iris, as well as oedema and destruction of the external layers of the retina. Exposure to a dose of 0.05 J/cm² and lower did not lead to destruction of any ocular structures or increase of intraocular pressure. The maximal dose causing no side effects for the organ of vision was established at 0.05 J/cm².

Vestn Oftalmol. 2001 Sep-Oct;117(5):11-4.

[Comparative effectiveness of different methods of quantum hemotherapy in the treatment of juvenile diabetic retinopathy]

[Article in Russian]

Nedzvetskaia OV.

Effects of ultraviolet exposure of the blood (UVEB), intravenous laser exposure of the blood (IVLEB), and transcutaneous magnetic laser exposure of the blood (TMLEB) on ocular functions, microcirculation, and hemodynamics were studied in 79 patients with juvenile diabetic retinopathy. All these treatments had a nonspecific positive effect on the spatial contrast sensitivity, microcirculation, and choroid hemodynamics of the eye. Correcting mainly intravascular changes in the microcirculatory bed, quantum hemotherapy methods are pathogenetically justified in the treatment and prevention of tissue ischemia in diabetic involvement of the organ of vision. Results of noninvasive TMLEB with generalized and local effects were statistically similar to results of invasive UVEB and