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Research Article

MICROPULSED TRANSSCLERAL CYCLOPHOTOCOAGULATION IN THE COMPLEX TREATMENT OF REFRACTORY GLAUCOMA

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ABSTRACT

According to modern concepts glaucoma is a disease or group of diseases accompanied by optic atrophy, characteristic changes in the visual field, the main risk factor of which is the increase of intraocular pressure (IOP) above the tolerance level.

KEYWORDS

Glaucoma, micropulse contact cyclophotocoagulation method.

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INTRODUCTION

Glaucoma is a socially significant disease. This is due to the fact that, along with its high prevalence, it leads to a high rate of disability in patients. According to WHO, there are currently over 106,000,000 patients with glaucoma worldwide. Glaucoma is the leading cause of amblyopia and blindness in Russia. According to Russian ophthalmologists, the incidence of vision loss from glaucoma is 28%. Despite the progress made in diagnosing and treating the early stages of the disease, some patients seek care when the disease reaches its terminal stage. The pain syndrome that sometimes accompanies this stage of the disease for years is a reason for having to remove the eye.

Surgical therapies effective in the initial stages of glaucoma have failed in the terminal stages of the disease. At the same time, drainage surgery is associated with severe complications, among which are noted hypotension, limitation of eyeball mobility, drainage protrusion, cystic filtration cushion formation, conjunctival erosion, implant displacement, hyphema, corneal epithelial-endothelial dystrophy.

Hypotension observed in the postoperative period can lead to serious complications such as ciliochoroidal detachment, suprachoroidal haemorrhages, hypotonic maculopathy, and corneal dystrophy. Organ-preserving surgery, which has gained momentum in the last decades, is becoming a priority in the treatment of terminal painful glaucoma, and is aimed primarily at eliminating the pain syndrome. Laser cyclodestructive techniques, which selectively suppress aqueous humor of the ciliary body with analgesic and hypotensive effects, have recently become more widely used in the treatment of terminal glaucoma. Laser cyclophotocoagulation techniques are increasingly being used in the treatment of terminal painful glaucoma, due to the advantages of technology such as reliability, efficiency, repeatability, and the advantages of equipment-technical ease of use of the equipment.

At the same time, with increasing experience, negative effects of contact transscleral diode laser cyclophotocoagulation (CTC) have become apparent. This technique may be followed by various complications such as reactive

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iridocyclitis up to 75.5%, uveitis 10-19%, hyphema 3.3%-11.4%, haemophthalmos 0.5-4%, hypotonia 0.8-18% with conversion into subatrophy of the eye 0.8-3.5%. The fact that such a great difference in the incidence of complications on the background of different energy components of laser intervention used by the authors confirms that today we cannot speak with certainty about development and introduction into clinical practice of an optimal technology of contact transscleral diode-laser CPC. Experimentally and clinically the dependence of eye reactions to contact transscleral diode-laser CPC on the total laser exposure energy was revealed. According to some authors, noted complications may be associated with overdose of laser energy, which ranges widely in power, exposure and coagulation amount. Until recently, laser transscleral techniques (diode-laser cyclocoagulation) were considered only as methods of reducing intraocular fluid (IOP) production through the damaging effect of laser radiation on the ciliary body processes. However, research in recent years has pointed to the possibility of less traumatic transscleral laser techniques (transscleral cyclocoagulation in micropulse mode, laser permeability activation technology) aimed at stimulating the outflow of humor through the uveoscleral pathway.

Currently, a new technique of diode transscleral micro-pulsed CPB (mCPC) with emission at a wavelength of λ = 810 nm is becoming increasingly popular. The diode laser emits a series of microsecond repetitive pulses. During the active phase of the radiation (ontime - duty cycle), a thermal effect on tissue containing melanin occurs. The cooling period of the tissue (offtime) lasts twice as long as the pulse itself. This promotes a return to the original tissue temperature and minimal damaging effects on the neighbouring structures of the eye. The gentle nature of the intervention explains the increasing interest of laser surgeons in using this transscleral technique to treat patients with glaucoma. There are now commercially available devices, in particular, the Cyclo G6 LaserSystem from IRIDEX, USA. Some published work on micropulsed cyclophotocoagulation (MCPC) has shown that there is no direct destruction of the ciliary body.

In 2016, S. Lin et al. performed ultrasound biomicroscopy of the limbal area before and after treatment and demonstrated the absence of gross morphological changes in the ciliary body, despite

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a clinically pronounced decrease in IOP. MengyaZhao et al. histologically confirmed that, unlike the continuous mode, diode laser radiation in the micropulsed mode does not cause destruction of the ciliary processes, theoretically indicating its less traumatic nature.

In a poster presentation in 2019 at ARVO (Association for Research in Vision and Ophthalmology Annual Congress in Vancouver), M.A. Johnstone et al. presented results demonstrating coagulation changes after laser exposure in the ciliary body and sclera, thereby demonstrating no direct laser-induced damage to the ciliary epithelium. The hypotensive effect is thought to be caused by an expansion of the space between the sclera and the ciliary muscle due to ciliary body tissue contraction caused by exposure to MCPC radiation, and hence, to mediated increase of the intraocular fluid outflow through the uveoscleral route. It is also indicated that this method causes contraction of the ciliary body muscle, producing a hypotensive effect by a mechanism similar to that of pilocarpine.

Micropulsed DCF has proven to be an independent and safe treatment for refractory glaucoma. Khojaev et al. demonstrated efficacy and safety of DCF in combination with non-penetrating deep sclerectomy and intravitreal injection of VEGF inhibitor in the combined treatment of patients with refractory forms of neovascular glaucoma.

Purpose of the study: was to improve the effectiveness of treatment of patients with terminal, aching glaucoma by micropulse contact cyclophotocoagulation

MATERIALS AND METHODS

Research was based on the analysis of data obtained from ambulatory records and operational reports of 40 patients at the preoperative stage and examination results in different terms after transscleral contact microimpulsed laser DPC surgery performed at the diagnostic and treatment centre "Yusupov Ltd" (13 patients) as well as at the eye department of 1st Clinic of Samarkand State Medical Institute (27 patients). 24 women (60%), 16 men (40%).

The patients' age varied from 62 to 86 years, on the average it was 70.1±5.76 years. The duration of terminal glaucoma ranged from 1.2 months to 8 years, with an average of 4.1±1.1 years.

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All patients suffered from ocular pain syndromes. The duration of pain syndrome ranged from 1 to 5 months (mean 3.2 ± 0.8). In 12 patients (30%) antiglaucoma standard (sinustrabeculoectomy) was previously performed for glaucoma, which failed to compensate intraocular pressure and pain syndrome.

All patients underwent transscleral cyclophotocoagulation in micropulse mode. Technique of contact transscleral cyclophotocoagulation with diode laser: after 3-4 times treatment of eyelid margins with betadine solution, retrobulbar solution of lidocaine 2% (4 ml) was injected, epibulbar solution of alkaine 2 drops 3 times with an interval of 2 minutes, sterile mask, blepharostat. Ciliary body was photocoagulated with micropulsed diode laser ("SubCyclo Supra-810") at a distance of 4 mm from the limbus in the projection of the flat part. The number of procedures for each patient was performed 2 to 3 times at intervals of 3 to 4 days. This procedure was fairly easily tolerated by patients, no adverse effects of the method received. After the procedure to relieve inflammation patients were prescribed 1% solution of preforte 2 times, as well as solution of Kupen forte 3 times a day. To dilate the pupil, we used a 2.5% midoptic solution 2 times for a week. In addition, Timolol 0.5% 2 times a day was used to lower IOP. A comprehensive ophthalmological examination of the patients has been carried out, as well as standard and special additional methods of investigation. In terminal pain glaucoma the visual function of the eye is permanently lost and there is often clouding of the transparent parts of the eye, so not all ophthalmological investigation methods are carried out in their entirety. Ophthalmological examination methods are mainly used to study the function of the paired intact eye.

Visual acuity was determined using the Golovin-Sivtsev table without correction and with full spectacle correction.

Ophthalmotonometry was performed using a Maklakov tonometer, with a weight of 10g, using epibulbar anesthesia, tetracaine solution (liquor) 1% 3 times. Circumferential diameter after tonometry was measured using B.L. Polyak ruler. Tonomography was performed using Filatov-Kalpha 5.0, 7.5, 10.0, 15.0 g weights. There were determined true intraocular pressure Po in mmHg, easy outflow coefficient C mm3 /min/mmHg, intraocular fluid production Fmm3/min, Becker coefficient Po/C.

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Computer perimetry was performed with HFA 740 (CarlZeiss), on the paired eye with threshold examination according to test 30-2, including examination of 72 points, central visual field, situated within 30° of fixation with a 4° pitch.

Ultrasound biomicroscopy was performed using an OcosanUS-4000 (USA): the anterior and posterior axes of the eye, anterior chamber depth, thickness, size, and position of the lens, as well as the condition of the vitreous body and retina were determined. Biomicroscopy was performed using slit lamp Shl-56 (Ukraine). The condition of cornea, pupils, iris, lens was studied in details, the depth of anterior chamber, iris dystrophy, synechia, pseudoexfoliative deposits and newly formed vessels were determined. Gonioscopy - the examination of the anterior chamber angle was performed in the presence of corneal transparency, under local anaesthesia, with a 3-mirror Goldman lens with 10x magnification and with a slit-lamp.

Ophthalmoscopy was performed on the paired eye without signs of glaucoma, by reverse and direct ophthalmoscopy, the aim of ophthalmoscopy was to determine pathological changes of the optic nerve, retina. During the examination of DZN its size, colour, borders, nature of excavation, ratio of excavation to DZN were evaluated.

Ultrasound biomicroscopy was performed using a Sonomed ultrasound (USA). Transducer was used with frequency of generated sound 50 MHz, resolution 5 μm, scanning frequency 8 MHz, which provided 5.0 x 5.0 mm width and depth of scanning.

RESULTS OF THE STUDY

To assess the effectiveness of ICPC in patients with terminal painful glaucoma we studied the following eye clinical parameters: eye pain, intraocular pressure level, anterior chamber biomicroscopy, eye ultrasound investigation as well as UBM indices, visual acuity (visiometry).

In preoperative period: observation of this group of patients in 37 cases (92.5%) revealed the lack of subject vision, in 3 eyes (7.5%) the presence of light sensation with incorrect light projection was determined. After LMDC there was no positive dynamics in relation to visual acuity in the studied group of patients, because visual acuity was extremely low due to the terminal stage of glaucoma.

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IOP values before laser transscleral cyclophotocoagulation in micropulse mode ranged from 39 to 65 mmHg (mean 47.2 mmHg). Immediately after the procedure, the intraocular pressure level decreased by 2.5 to 3.5 times from the initial intraocular pressure level. If before the operation, IOP level of 50 mmHg and more was observed in 75% (30 eyes) of the patients, IOP level reached 30 mmHg and lower on the 3rd day after the operation, reaching 80% (32 eyes). Ophthalmotonus of the eyes with terminal pain glaucoma averaged 30.45±6.79 mmHg during the first week after the procedure. Before laser procedure, these patients used 2-5 types of anti-glaucoma drops a day to reduce IOP, which failed to normalise and reduce IOP. After the laser treatment, 60% (24) of the patients had IOP levels in the upper range of the age norm, while at the same time all pain symptoms disappeared, which was a prerequisite for withdrawal of the anti-glaucomatous drugs in these patients. When the ophthalmotonus level reached 33 mmHg, one type of anti-glaucomatous drug (timolol) was prescribed to compensate IOP in these patients. In the patients we examined, there were 10 (25%) such patients. In 6 (15) patients IOP was greater than 33 mmHg, these patients did not need one type of anti-glaucoma medication to relieve IOP, so 2 types of anti-glaucoma medications (timolol and taflothane) were prescribed.

CONCLUSIONS

Thus, after ICPC, the use of antiglaucoma drugs decreased more than 2-fold, which averaged 1.1. IOP of the paired healthy eye did not exceed 22 mmHg in all cases, averaging 18.95±1.42 mmHg.

Ultrasound biometry of the eyeball averaged 23.57 ± 0.87 mm (22.51 to 24.01 mm) and did not differ from the healthy eye of this patient. However, the lens thickness of the eyes with terminal glaucoma was slightly greater compared to the healthy eye, with an average of 3.9 mm versus 3.45 mm. The ultrasound scan revealed marked destruction of the vitreous body and floating opacities in all cases, with conglomerate inclusions in the anterior parts of the vitreous body in 18 cases (45 %) and detachment of hyaloid membrane in 7 cases (1 %). In paired eyes without glaucoma changes of the vitreous body corresponded to age data and were shown by coarsening of local posterior vitreous detachment in 7 eyes (17,5 %).

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Biomicroscopic examination revealed corneal edema in 18 (45%), corneal epithelial-endothelial dystrophy in 25 (62.5%), precipitates on corneal endothelium in 8 (20%), iris rubeosis in 23 eyes (57,5%), anterior and posterior synechias in 22 cases (55%), diffuse lens opacity in 31 cases (77,5%), antiglaucomatous operations in 12 eyes (30%), hyphema in 5 eyes (12,5%). According to results of biomicroscopy of paired eyes in all cases cornea was transparent, anterior chamber was of medium depth, a lens had cataract opacities of various intensity mainly with mixed localisation, involving cortical and nuclear layers of the lens. Pseudoexfoliative syndrome accompanying cataract opacities occurred in 19 (47.5%) cases. Immediately after ICPC the cornea became transparent in 16 patients, and in 2 patients the intensity of edema slightly decreased. Congestion and intensity of rubeosis decreased in almost all cases. Corneal opacity and corneal epithelial-endothelial dystrophy remained at the same level. Anterior chamber depth slightly deepened in 32 patients, the remaining 8 patients remained unchanged.

Pain syndrome in the affected eye was completely eliminated in 33 patients (82.5%), in 7 cases (17.5%) it was not achieved. In all 7 cases, the pain syndrome was not resolved, but patients reported feeling relief after the procedure. With the use of analgesics, the patients had a restful night before the procedure. In these patients the postoperative period was accompanied by a pronounced uveal inflammatory reaction. These patients received additional steroid therapy in the form of pre-forme eye drops, 2 drops 3 times a day, for 10 days, and nonsteroidal anti-inflammatory solution of diclofenac in combination with anti-glaucomatous preparations (Timalol). Prostaglandins have not been used due to eye irritation as prostaglandins mediate inflammation. After elimination of the inflammatory process in this eye these patients underwent repeated micropulse transscleral cyclophotocoagulation according to the standard technique. Immediately after the repeated procedure, the pain in the eye disappeared.

On ultrasound biometry of patients with terminal pain glaucoma, the anterior-posterior axis (APA) of the eye averaged 23.29 ± 0.17 mm (22.58 to 23.93 mm), with no significant difference from the paired eye, where the APA was 23.16 ± 0.19 mm (22.56 to 23.96 mm).

Gonioscopy of eyes with terminal painful glaucoma revealed the presence of planar

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synechiae (12 eyes - 30 %), AAC neovascularization (17 eyes - 42,5 %), the degree of trabecula was grade 3-4 (in case of open AAC). In 32 cases, the AAC was not visualised due to corneal oedema or opacity. On gonioscopy of eyes without glaucoma (comparison group), the AAC was visualised with the ability to view the identifying areas and no goniosynechias were present. In eyes with terminal glaucoma, ophthalmoscopy revealed optic disc atrophy, marginal glaucomatous excavation and shift of the vascular bundle to the bulge.

Ophthalmoscopically in the comparison group (without the presence of glaucoma), the correct position of the vascular bundle of the TZN and the E/D ratio were noted.

Preoperative examination of eyes with terminal glaucoma using UBM revealed a varying degree of CD atrophy which was acoustically manifested by reduced thickness of the ciliary body. The ciliary body thickness of eyes with terminal glaucoma averaged 0.53 ± 0.09 mm (0.37 to 0.74 mm), significantly

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