RESULTS OF MICROPULSE TRANSSCLERAL CYCLOPHOTOCOAGULATION IN THE TREATMENT OF NEOVASCULAR GLAUCOMA IN PROLIFERATIVE DIABETIC RETINOPATHY

Azamat F. Yusupov - D.M.Sc., professor
Muyassar Kh. Karimova - D.M.Sc., professor
Shirin A. Dzhamalova - D.M.Sc., associate professor
Azizbek K. Jalalov - basic doctoral researcher
Nurbek Sh. Khaitboev - resident
Republican Specialized Scientific and Practical Medical Center of Eye Microsurgery (Tashkent, Uzbekistan)
nurbekxaitboyev@gmail.com

Abstract. *Neovascular glaucoma (NVG) associated with proliferative diabetic retinopathy (PDR) represents the most severe form of secondary glaucoma. This paper presents the results of micropulse transscleral cyclophotocoagulation (MP-TSCPC) in 10 patients with NVG secondary to PDR. At 6-month follow-up, a statistically significant mean IOP reduction of 61.2% was observed along with improved best-corrected visual acuity, with no serious adverse events.*

Keywords: *neovascular glaucoma, proliferative diabetic retinopathy, micropulse trans-scleral cyclophotocoagulation, MP-TSCPC, intraocular pressure, iris rubeosis, type 2 diabetes mellitus.*

Introduction.

Neovascular glaucoma (NVG) is one of the most severe complications of proliferative diabetic retinopathy (PDR) and occupies a special place among secondary glaucomas due to its aggressive course, marked refractoriness to conventional hypotensive therapy, and high risk of irreversible vision loss [1]. According to the literature, NVG develops in 2–21% of patients with diabetes mellitus and diabetic retinopathy, and in the vast majority of cases it is associated with PDR and chronic retinal ischemia [2].

The pathogenetic basis of NVG is abnormal neovascularization of the anterior segment of the eye induced by overproduction of vascular endothelial growth factor (VEGF) under conditions of retinal hypoxia. Proliferating new vessels of the iris (rubeosis iridis) and the anterior chamber angle form a fibrovascular membrane that progressively obstructs aqueous humor outflow pathways, leading to a sharp increase in intraocular pressure (IOP) [3].

Micropulse transscleral cyclophotocoagulation (MP-TSCPC) is a modern, tissue-sparing method for reducing ophthalmotonus, based on selective воздействия on the pigmented epithelium of the ciliary body using interrupted laser energy delivery. Unlike conventional continuous-wave cyclophotocoagulation, MP-TSCPC causes significantly less destructive damage to surrounding tissues, which is especially important in refractory NVG in patients with severe concomitant retinal pathology [4,5].

Objective. To evaluate the clinical and functional outcomes of MP-TSCPC in the comprehensive treatment of NVG associated with PDR based on a series of 10 clinical cases.

Material and methods of research.

The case series included 10 patients (15 eyes with NVG) diagnosed with secondary neovascular glaucoma associated with proliferative diabetic retinopathy, who were treated at the Republican Specialized Scientific and Practical Medical Center of Eye Microsurgery during 2025–2026. All patients had type 2 diabetes mellitus. The mean age was 59.2.

Inclusion criteria were: confirmed NVG associated with active PDR, IOP ≥ 30 mmHg despite maximum medical therapy, presence of iris rubeosis, and a history of previous antiglaucoma interventions. All patients underwent MP-TSCPC using the Quantel Medical 810 nm laser system (parameters: power 2000 mW, duty cycle 31.3%, exposure time 80–100 s). Panretinal laser photocoagulation (PRP) was performed in all patients either during the preparatory stage or simultaneously.

The examination included visual acuity testing, contact and non-contact tonometry, biomicroscopy, ophthalmoscopy, retinal OCT (Maestro2, Topcon), computerized perimetry (Tomey), B-scan ultrasonography (Sonomed Escalon), and A-scan biometry. The follow-up period was 6 months. Statistical analysis was performed using the paired t-test, with $p < 0.05$.

Table 1.

Clinical characteristics of patients

No.	Patient	Age	Sex	Affected Eye	IOP Before MP-TSCPC (mmHg)	Visual Acuity Before
1	M.	55	Male	OU	OD: 38, OS: 38	OD: 0.01, OS: 0.04
2	T.	61	Male	OU	OD: 36, OS: 34	OD: 0.02, OS: 0.02
3	Kh.	58	Female	OS	OD: 18, OS: 41	OD: 0.4, OS: 0.02
4	R.	63	Male	OD	OD: 44, OS: 16	OD: 0.01, OS: 0.3
5	K.	52	Female	OU	OD: 35, OS: 39	OD: 0.02, OS: 0.01
6	A.	67	Male	OU	OD: 42, OS: 37	OD: 0.01, OS: 0.02
7	N.	49	Female	OS	OD: 17, OS: 40	OD: 0.3, OS: 0.01
8	U.	71	Male	OU	OD: 33, OS: 36	OD: 0.02, OS: 0.02
9	Zh.	56	Female	OD	OD: 45, OS: 18	OD: 0.01, OS: 0.2
10	S.	60	Male	OU	OD: 37, OS: 40	OD: 0.02, OS: 0.01

Results. Six months after MP-TSCPC, a significant reduction in intraocular pressure was observed in all cases. The mean IOP before treatment was 38.4 ± 3.8 mmHg, which decreased to 14.9 ± 1.6 mmHg after treatment (a 61.2% reduction; $p < 0.001$). Target IOP (≤ 18 mmHg) was achieved in 14 out of 15 eyes (93.3%). The dynamics of pre- and post-treatment parameters are presented in Table 2.

Table 2.

Dynamics of Clinical Parameters Before and After MP-TSCPC (at 6-Month Follow-Up*)*

No.	IOP Before/After (mmHg)	Visual Acuity Before/After	Perimetry MD (dB)
1	OD: 38 / 14, OS: 38 / 12	OD: 0.01 / 0.03, OS: 0.04 / 0.08	OD: -29.5, OS: -16.0
2	OD: 36 / 16, OS: 34 / 14	OD: 0.02 / 0.04, OS: 0.02 / 0.05	OD: -26.3, OS: -24.1
3	OD: 18 / 16, OS: 41 / 15	OD: 0.4 / 0.4, OS: 0.02 / 0.05	OD: -4.2, OS: -28.7
4	OD: 44 / 17, OS: 16 / 15	OD: 0.01 / 0.02, OS: 0.3 / 0.3	OD: -31.2, OS: -6.1
5	OD: 35 / 13, OS: 39 / 15	OD: 0.02 / 0.04, OS: 0.01 / 0.03	OD: -22.4, OS: -27.8
6	OD: 42 / 18, OS: 37 / 16	OD: 0.01 / 0.03, OS: 0.02 / 0.04	OD: -33.1, OS: -25.6
7	OD: 17 / 15, OS: 40 / 14	OD: 0.3 / 0.3, OS: 0.01 / 0.03	OD: -3.8, OS: -30.2
8	OD: 33 / 15, OS: 36 / 17	OD: 0.02 / 0.04, OS: 0.02 / 0.05	OD: -24.7, OS: -22.3
9	OD: 45 / 16, OS: 18 / 16	OD: 0.01 / 0.03, OS: 0.2 / 0.2	OD: -34.5, OS: -5.4
10	OD: 37 / 14, OS: 40 / 13	OD: 0.02 / 0.05, OS: 0.01 / 0.04	OD: -27.9, OS: -29.1
Mean	38.4 / 14.9	—	—

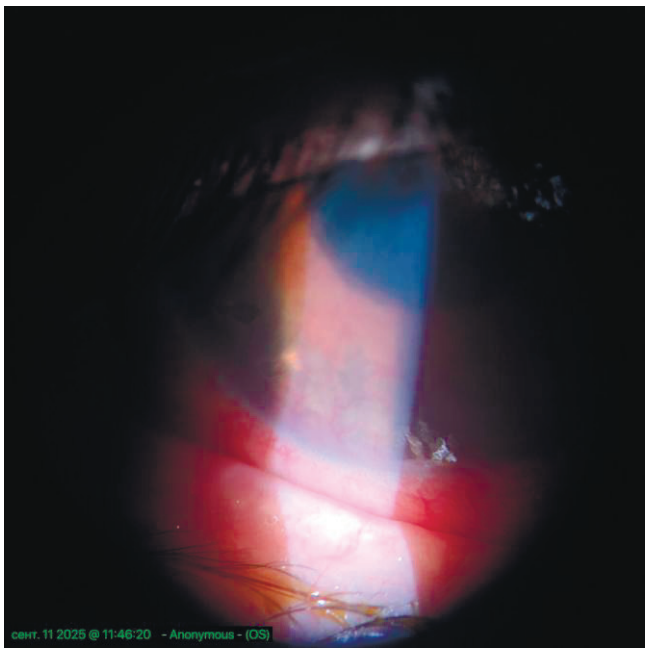


Figure 1. Rubeosis iridis of the left eye (patient M., 55 years old): newly formed vessels on the iris surface in neovascular glaucoma associated with proliferative diabetic retinopathy (September 2025)

Visual acuity improved or remained stable in all cases. No progression of glaucomatous optic disc cupping was detected on OCT. No complications (hypotony, phthisis bulbi, or bullous keratopathy) were observed. Partial regression of iris rubeosis following panretinal laser photocoagulation (PRP) was noted in 7 out of 10 patients.

Discussion. The obtained results demonstrate the high hypotensive efficacy of MP-TSCPC in refractory neovascular glaucoma in patients with proliferative diabetic retinopathy. The 61.2% reduction in IOP is consistent with published data: Aquino et al. reported a 35–40% reduction in IOP following MP-TSCPC in patients with refractory glaucoma [7]. A key advantage of this method is the preservation of residual visual function due to its tissue-sparing mode of action without total destruction of the ciliary body [5,7].

The wave-like pattern of IOP changes observed in some cases (increase to 38–45 mmHg followed by normalization) indicates the instability of ocular hydrodynamics in NVG and highlights the need for timely MP-TSCPC before irreversible optic nerve damage develops [3,4]. Partial regression of iris rubeosis following PRP in 70% of patients confirms the pathogenetic rationale for a comprehensive treatment approach [6].

Thus, a differentiated treatment strategy for NVG associated with PDR should include: (1) elimination of retinal ischemia (PRP, anti-VEGF therapy); (2) surgical IOP control using MP-TSCPC; and (3) systemic management of diabetes mellitus [1,3,5].

Conclusion. Micropulse transscleral cyclophotocoagulation is an effective and safe method for IOP control in refractory neovascular glaucoma associated with proliferative diabetic retinopathy. In this series of 10 patients, the method provided a mean IOP reduction of 61.2% without serious complications and with preservation of residual visual function. A comprehensive approach including MP-TSCPC combined with panretinal laser photocoagulation and systemic diabetes control makes it possible to achieve stabilization of ophthalmotonus in this severe category of patients.

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