
*Original Article*OUTCOME OF SUBCYCLO DIODE LASER TRANSSCLERAL
CYCLOPHOTOCOAGULATION FOR TREATMENT OF GLAUCOMA

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Abstract

Purpose: The purpose of this study was to evaluate the efficacy and safety of micropulse transscleral cyclophotocoagulation (MP-TSCPC) for the treatment of glaucoma in patients whose condition was not controlled with maximum tolerated antiglaucoma drugs or who were unable to adhere to medication regimens. **Methods:** This prospective interventional study included 30 eyes from 22 patients treated at the Ophthalmology Department of Qena University Hospital between January 2023 and January 2024. Patients underwent MP-TSCPC using the SubCyclo Vitra 810 laser. Baseline and follow-up assessments at 1 week, 2 weeks, 1 month, 3 months, and 6 months included intraocular pressure (IOP) measurements, best-corrected visual acuity (BCVA), and the number of antiglaucoma drugs used. Success was defined as achieving an IOP between 6 and 21 mmHg with or without antiglaucoma drugs, or a reduction in IOP of at least 20% from baseline. **Results:** The mean age of participants was 55.93 years, with an equal distribution of male and female patients. The majority (70%) had open-angle glaucoma. The mean number of antiglaucoma drugs significantly decreased from 3.17 ± 0.93 at baseline to 1.20 ± 1.22 at 6 months ($p < 0.0001$). Baseline IOP was 26.7 ± 3.18 mmHg, which significantly reduced to 16.87 ± 2.23 mmHg at 6 months ($p < 0.0263$). BCVA remained stable throughout the study period. The success rate was 86.67%, with minimal complications observed. **Conclusion:** MP-TSCPC is an effective and safe treatment modality for glaucoma, particularly for patients with difficulty adhering to medication or those unwilling to undergo invasive surgery. The procedure significantly reduces IOP and the need for antiglaucoma medications while preserving visual acuity with minimal complications.

Keywords: Glaucoma, Micropulse Transscleral Cyclophotocoagulation, MP-TSCPC, Intraocular Pressure, Antiglaucoma Medications, Visual Acuity, Minimally Invasive Surgery.

1. Introduction

Glaucoma is a difficult disease, difficult to diagnose and difficult to treat. Despite the new diagnostic and therapeutic tools, it is still one of the leading causes of irreversible vision loss [1]. Vision loss in glaucoma is due to progressive damage

of the retinal nerve fibers and optic nerve head. In most cases, there is association of high intraocular pressure (IOP) [2]. The current therapies are directed to lowering the IOP. These therapies include medications (topical eye drops), laser therapy

(argon laser trabeculoplasty, diode laser photocoagulation) and incisional surgery (Trabeculectomy or minimally invasive surgery, e.g., deep sclerectomy) [3,4]. Transscleral cyclophotocoagulation (TSCPC) with diode laser delivers energy to the ciliary body that is absorbed by melanin pigment in the ciliary body epithelium and hence, destroys the ciliary body. This diminishes the aqueous humor production and, consequently, decreases the IOP [5]. Continuous wave (CW) TSCPC has been used to treat patients with refractory glaucoma with poor visual potential. Most of the CW TSCPC complications are correlated with the amount of energy delivered to the ciliary body. High energy ablation may extend beyond the targeted area producing collateral damage to the adjacent epithelium and consequently complications such

2. Methods

This prospective interventional study was conducted at the Ophthalmology dep., Qena Univ. Hospital between January 2023, and January 2024. The research was performed according to the principles of the Helsinki Declaration. All participants provided a signed consent before the procedure. This study included 30 eyes of 22 patients who have glaucoma (IOP more than 21 mmHg) not controlled with maximum tolerated antiglaucoma drugs or unable to adhere with medication. Exclusion criteria included patients with any previous glaucoma surgery, pacific cataract, diabetic retinopathy, and corneal opacities patient who have Best-corrected visual acuity (BCVA) less than 3/60 were excluded. Best-corrected visual acuity (BCVA), IOP, number of antiglaucoma drugs and any postoperative complications such as intraocular inflammation or hypotony were registered at every time point, up to the last follow-up at 6 months. All patients received retrobulbar anesthesia before the surgery in the operative room. The laser

3. Results

In the presented study, demographic and ocular characteristics of the participant

as hypotony, intraocular inflammation, and loss of eye contour [6]. Micropulse transscleral cyclophotocoagulation (MP-TSCPC) is a novel technique that modulates and reduces the energy delivered to the ciliary body that would minimize complications without losing the IOP lowering effect. Its idea depends on chopping of continuous wave into a series of repetitive short pulses of laser treatment with each pulse of active "On" laser separated by a long "Off" period. The "Off" period allows the ciliary body to cool and thus avoiding collateral damage to the adjacent tissues [7]. Published studies have shown safety of using MP-TSCPC and its good IOP lowering effect in different types of glaucoma [8,9]. The aim of the study is to evaluate the efficacy and safety of MP-TSCPC for treatment of eyes with glaucoma.

was delivered using SubCyclo Vitra 810 (Quantel Medical Instruments, Cournon d'Auvergne Cedex, France). The parameters were standardized for all patients: Power 2000 mW and duty cycle at 31.3% was delivered. The laser probe was placed over the conjunctiva 3 mm behind the limbus. It was held perpendicular to the globe with firm pressure and moved in a slow and continuous fashion like painting. The laser treatment was done on superior and inferior arcs and lasted for 160 seconds (80 second for each arc) avoiding treatment of the 3 and 9 o'clock meridians. Post-operatively all patients received a combination of drugs (tobramycin and dexamethasone) for 1-2 weeks. Patients were advised to continue on their antiglaucoma drugs and readjusted at each follow up according to IOP. Success was defined as both: IOP between 6 and 21 mmHg or reduction of IOP by at least 20% from baseline with or without antiglaucoma drugs.

cohort (N= 30) were analyzed. The mean age of the participants was 55.93 years,

with a standard deviation of 10.67 years. Gender distribution was equal, with 50% male and 50% female participants. Regarding the type of angle, 70% of participants exhibited open-angle glaucoma (OAG), while 26.67% presented with angle-closure glaucoma (ACG), and 3.33% had silicone-filled eyes. Lens status varied, with 83.33% of participants being phakic and 16.67% pseudophakic, tab. (1). Comparing the number of drugs taken by patients at baseline and after 6 months. At baseline, the mean number of drugs was 3.17 ± 0.93 . After 6 months, the mean number of drugs significantly decreased to 1.20 ± 1.22 . The p-value for this change is less than 0.0001, indicating that the reduction in the number of drugs taken by patients over the 6-month period is statistically significant. The percentage reduction in the mean number of drugs is approximately 62.15%. However, the baseline BCVA was 0.67 ± 0.46 , with no significant change observed after 6 months ($p=0.7872$), tab. (2). The baseline IOP was 26.7 ± 3.18 mmHg,

which significantly decreased to 21.73 ± 4.44 mmHg at 15 days post-management ($p < 0.0001^*$). The reduction in IOP was sustained over time, with values of 19.57 ± 5.63 mmHg at 1 month ($p=0.0626$), 19.67 ± 4.92 mmHg at 3 months ($p=0.8588$). However, it significantly reduced to 16.87 ± 2.23 mmHg at 6 months ($p=0.0263$), tab. (3). The total change in BCVA averaged 0.13 ± 1.18 , while the total change in IOP averaged -9.83 ± 3.62 . This resulted in an average reduction in IOP of $36.07 \pm 10.97\%$, tab. (4). Success was achieved in 26 subjects, representing 86.67% of the cohort, while 4 subjects experienced failure, constituting 13.33% of the total. Following re-treatment, the mean Intraocular Pressure (IOP) measured 18 ± 1.22 mmHg, indicating a decrease from baseline by 5.25 ± 1.3 mmHg, corresponding to a reduction percentage of $22.51 \pm 5.13\%$. Half of the cases (50%) achieved success following re-treatment.

Table 1: Demographic and ocular data among included patients

	Value (N = 30)
Age (Years)	55.93 ± 10.67
Sex	
▪ Male	15 (50%)
▪ Female	15 (50%)
Type of angle	
▪ OAG	21 (70%)
▪ ACG	8 (26.67%)
▪ Silicon filled	1 (3.33%)
Lens status	
▪ Phakic	25 (83.33%)
▪ Pseudophakia	5 (16.67%)

Table 2: Comparison of number of drugs and BCVA at baseline and after 6 months among included patients.

	At base line (N = 30)	After 6 months (N = 30)	P. Value
Number of drugs	3.17 ± 0.93	1.20 ± 1.22	$P < 0.0001^*$
BCVA	0.67 ± 0.46	0.8 ± 1.08	$0.7872^{[MWU]}$

Table 3: IOP Measurement through the study

	At base line (N = 30)	After 15 days (N = 30)	After 1 month (N = 30)	After 3 months (N = 30)	After 6 months (N = 30)
IOP (mmHg)	26.7 ± 3.18	21.73 ± 4.44	21.32 ± 4.56	19.67 ± 4.92	16.87 ± 2.23
P. Value (each with previous measurement)		$< 0.0001^{[MWU]}$	$0.0626^{[MWU]}$	$0.8588^{[MWU]}$	$0.0263^{[MWU]}$
PF	$P_F < 0.0001^*$				

Table 4: BCVA and IOP total change

	Value (N = 30)
BCVA Total Change	0.13 ± 1.18
IOP Total Change	-9.83 ± 3.62
IOP Reduction Percentage	36.07 ± 10.97

4. Discussion

The use of MP-TSCPC for treatment of glaucoma is increasing as a minimally invasive tool over more than 10 years [10-12]. The findings of this study showed effectiveness of MP-TSCPC after 6 months follow-up. The IOP was significantly decreased with reduction of antiglaucoma drugs. The visual acuity was preserved with minimal complications. The mechanism of action of MP-TSCPC is not well established, yet possible mechanisms were suggested. The first mechanism decreases production of aqueous humor through its absorption by the pigmented ciliary epithelium and the technique of on/off laser delivery denatures proteins with reduction of aqueous humor without thermal disruption of adjacent cells [13]. The second mechanism involves increasing the uveoscleral outflow, evidenced by the presence of fine spaces between the sclera and the ciliary body [14]. The third one through increasing the trabecular outflow by its action on the longitudinal fibers of the ciliary body, which when contracted results in displacement of scleral spur. An effect similar to the lowering mechanism of pilocarpine [15]. The success rate in this study was 86.6% after 6 months follow-up. MP-TSCPC proved to be effective in lowering the IOP in many studies, yet there are wide variations in the success rates. The diversity of results is attributed to many factors like treatment parameters, selection of cases, definition of success, and duration of follow-up [6]. Megacho et al. [16]. demonstrated a success rate of 86.5% which is similar to the results of this study. The protocol used was 2000

mW with a 31.3% duty cycle that was used in our study. The use of a protocol with delivery of low laser energy showed lower success rates, as in the study by Sarrafpour et al. [17], in which the delivered energy was 100 J with a 30% success rate. Most of the patients in this study have POAG, which may explain the higher success rate. Yelenisky et al. [18]. Postulated those eyes with POAG showed a higher success rate than eyes with neovascular glaucoma (NVG) or other diagnoses. In this study, retreatment was done in 4 eyes (13.4%) and this percentage may be related to the preoperative IOP which was 26.7 mmHg. In studies with higher preoperative IOP (greater than 30 mmHg), the retreatment exceeded 20% [19,20]. In this study, the number of antiglaucoma drugs was reduced from 3.17 at baseline to 1.2 at the end of the follow-up. Previous research has found a significant reduction of antiglaucoma drugs ranging from 2.1 to 4.7 at baseline to 1.3 to 3.6 at the end of follow-up [5]. In our series, no cases showed a decrease in BCVA, indicating the safety of the procedure. Preservation of vision was noticed in previous studies [4,8]. The low incidence of vision loss suggests a minimally invasive treatment in sighted eyes. In addition to the preservation of vision, MP-TSCPC has minimal complications. Four cases had anterior uveal inflammation that extended for 1 month, while in most cases, inflammation was resolved within 1-2 weeks by the use of topical steroid medications. Postoperative iritis was reported as a complication in 3-3.7% of cases [6].

5. Conclusion

MP-TSCPC appears to be an effective and safe modality for the treatment of glaucoma, not controlled with maximum tolerated glaucoma therapy. Also, for patients who have complications due to medical treatment or not willing to do invasive glaucoma surgery.

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