

The outcome of ciliary body ablation with diode laser contact transscleral cyclophotocoagulation in 6 months follow-up

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HIGHLIGHTS

Cyclophotocoagulation aims to reduce aqueous humor production by destroying the ciliary body and still is an important treatment option for all types of glaucoma. We reflected on the usefulness of continuous-wave diode cyclophotocoagulation for the management of refractory glaucoma, and discussed results concerning visual acuity, lowering intraocular pressure and taking medications by the patients, as well as the safety profile of the procedure.

ABSTRACT

The aim of the study is to analyse the postoperative results of continuous wave, transscleral cyclophotocoagulations (CW-TSCPC) in 6 months follow-up for patients with refractory glaucoma.

Material and methods: We retrospectively reviewed 58 records of patients who underwent the transscleral cyclophotocoagulation because of refractory glaucoma at the Department of Ophthalmology, Poznan University of Medical Sciences, Poland, between 2016 and 2022. All patients underwent ophthalmological examination at baseline and during follow-up visits including best-corrected visual acuity, intraocular pressure measurement (IOP), slit-lamp examination, visual field and optical coherence tomography examination of the retinal nerve fiber layer (OCT RNFL). Follow-up time was 6 months.

Results: We analyzed a group of 58 patients (28 women and 30 men, average age of 62). Majority of patients (41 eyes, 70.69%) had secondary open angle glaucoma. There were no serious complications of the CW-TSCPC procedure. We achieved IOP normalization (IOP below 22 mmHg) in 81.03% of eyes in 1 month follow-up, in 81.08% after 2 months, and in 72.41% after 6 months. Mean IOP reduction was 53.47%, 47.71%, and 47.65% from baseline at 1, 2, and 6 months, respectively. The number of medications taken by patients was lowered of 74.14%, 70.27% and 68.97% after 1, 2 and 6 months respectively. 17 eyes (29.31%) required additional surgical interventions within 6 months.

Conclusions: CW-TSCPC is an effective and safe procedure. It allows lowering of IOP and reduction of drugs number administrated by patients with various types of glaucoma during 6 months follow-up. The procedure is technically easy and with well-controlled postoperative complications.

Key words: continuous wave laser, diode laser, refractory glaucoma, transscleral cyclophotocoagulation

INTRODUCTION

Transscleral cyclophotocoagulation (TSCPC) is a procedure that reduce the production of aqueous humor by damaging the secretory epithelium of the ciliary body. Melanin of the ciliary processes absorbs laser energy, which induces the process of thermal coagulation [1]. TSCPC can be performed with an 810 nm diode laser or a neodymium yttrium-aluminum-garnet (Nd:YAG) laser with a wavelength of 1064 nm. The light with a wavelength of 810 nm is better absorbed by the ciliary body, thanks to which the laser acts most selectively, is more efficient and causes less inflammation of the surrounding tissues than Nd:YAG laser. The diode laser can be used in a contact form with the use of a probe (placed directly on the eyeball in the projection of the folded part of the ciliary body) [2]. The indications for surgery are primary and secondary glaucoma, e.g. when previous surgical methods have failed to achieve a satisfactory reduction of intraocular pressure (IOP) or there are some contraindications for other surgery [1]. The main possible complications include perioperative and postoperative pain, but they are usually transient and well-controlled with analgesics. Others are: transient IOP increases or the need to repeat the procedure, hypotony, bleeding, hyphema, inflammation, decreased visual acuity (VA), conjunctival burns, anterior uveitis, eyeball atrophy [3]. The full effect in lowering IOP may take up to 4 weeks [1]. The aim of the study was to present the postoperative results of continuous wave, transscleral cyclophotocoagulations (CW-TSCPC) in 6 months follow-up for patients suffering from all types of refractory glaucoma.

MATERIAL AND METHODS

We retrospectively reviewed 58 records of patients who underwent the transscleral cyclophotocoagulation because of refractory glaucoma at the Department of Ophthalmology, Poznan University of Medical Sciences, Poland, between 2016 and 2022. We used Iridex Medical OcuLight® SLx laser (infrared 810 nm) for the contact method. All patients underwent ophthalmological examination at baseline and during follow-up after 1, 2 and 6 months after surgery, including best-corrected visual acuity (BCVA), intraocular pressure measurement (IOP), slit-lamp examination, visual field examination and OCT RNFL examination. We investigated postoperative complications and number of antiglaucoma eyedrops taken by the patients. Patients selected for surgery had refractory glaucoma and were on maximal local therapy (eyedrops with or without oral carbonic anhydrase inhibitor) or had uncontrolled glaucoma despite prior medical therapy or surgical procedures. TSCPC was performed under local (retrobulbar) anesthesia. The retrobulbar injection consisted of a 2 : 3 mix of 2% lidocaine and 0.75% bupivacaine. A handpiece called

G-probe transmitted the laser energy. We centered it 1.2–1.5 mm posteriorly from the corneoscleral limbus, with sparing the 3 o'clock and 9 o'clock positions because of ciliary nerves and vessels lying. After ensuring that the footplate is in complete contact with ocular surface, we pressed a little a probe to conjunctiva and sclera to avoid the burns and to transmit energy properly. The power of diode laser ranged 800–2500 mW, pulse duration was 1.5–2.5 s, and the number of applications ranged 20–24. We moved the footplate clockwise by one half the probe's width after each application of laser energy, achieving 360 degrees. Follow-up period after procedure ranged 1–6 months. All patients signed consent to the surgical procedures and the study was conducted in accordance with Helsinki Declaration.

RESULTS

We analyzed results of 58 of patients who underwent CW-TSCPC, including 28 women and 30 men, average age of 62 (min. 21, max 95, median 65 years). We examined the patients ophthalmologically in 1st month, 2nd month and 6th month after the surgery.

The majority of patients (41 eyes, 70.69%) were diagnosed with secondary open-angle glaucoma (SOAG), 8 patients (13.79%) primary open-angle glaucoma (POAG), 3 patients were diagnosed with secondary angle-closure glaucoma (SACG) and 6 with primary angle-closure glaucoma (PACG), as shown in details in table 1.

TABLE 1

Classification by the etiology of optic nerve glaucomatous neuropathy treated with CW-TSCPC.

Indications for CW-TSCPC	Number of eyes	Percent of eyes [%]
POAG	8	13.79
SOAG	41	70.69
PACG	6	10.35
SACG	3	5.17
Silicone oil induced glaucoma	6	10.34
Others	6	10.34
Inflammatory glaucoma	3	5.17
Glaucoma in genetical or congenital abnormalities	3	5.17
Glaucoma after trauma	7	12.07
Neovascular glaucoma	5	8.62

PACG – primary angle-closure glaucoma; POAG – primary open-angle glaucoma; SACG – secondary angle-closure glaucoma; SOAG – secondary open-angle glaucoma.

We achieved IOP normalization (below 22 mmHg) in 47 eyes (81.03%), in 30 (81.08%), and in 21 eyes (72.41%), after 1, 2 and 6 months respectively.

On average, IOP reduction after procedure was 13.07 mmHg (42.98%), 12.86 mmHg (42.29%) and 12.97 mmHg (42.65%) after one surgical procedure compared to the baseline IOP, respectively after 1, 2 and 6 months.

17 (29.31%) patients required additional surgical interventions within 6 months in order to lower IOP. Four patients with angle-closure glaucoma (ACG) needed the reoperation (44% of patients with CAG) in short follow-up time (1–2 months).

We obtained good IOP controlled with limited number of medications in 43 patients (74.14%) after one month, in 26 patients (70.27%) after 2 months and we maintained the results among 20 patients (68.97%) during 6 months follow-up after one surgery procedure. The effect of reducing the number of drugs taken by patients is listed in table 2.

in 63–89% of cases [4–6]. We achieved rewarding target of IOP below 22 mmHg in 81% after 1 month follow-up, in 81% after 2 months follow-up and 72% in 6 months follow-up.

There is an investigation that indicates CW-TSCPC to be most effective in patients with chronic angle-closure glaucoma (93% successful lowering of IOP) and the lowest reoperation rate [6]. It is in contrary to our investigation as patients with angle-closure glaucoma (ACG) most often needed reoperation during 6 months follow-up. However, the limitation of our study is a small group of patients with ACG.

Other authors report the reduction of patients' topical and systemic glaucoma medication use (particularly the use of oral acetazolamide after CW-TSCPC) range 55–80% [7, 8]. We obtained the reduction of drugs intake in nearly 74% of patients during a 1-month follow-up, in 70% of patients in 2-months follow-up and in almost 69% in 6-months fol-

TABLE 2

Reduction of IOP and drugs intaking by the patients.

Results after CPC	Number of eyes	Percent of eyes [%]	Number of eyes	Percent of eyes [%]	Number of eyes	Percent of eyes [%]
Time of check-up	1 month		2 months		6 months	
All medications unchanged	15	25.86	8	21.62	5	17.24
Medications were added	0	0.00	3	8.12	4	13.80
Other procedure performed	4	6.90	6	16.21	7	24.14
Without medications	2	3.45	2	5.41	2	6.90
Total medications' intake reduction	43	74.14	26	70.27	20	68.97
All of controlled eyes	58	100.00	37	100.00	29	100.00

In relation to best corrected visual acuity (BCVA) before surgery, 20 patients (34.48%) had VA deterioration (at least 1 line on Snellen chart) since surgery. We treated 15 patients presenting BCVA 0.3 or better and 5 patients (33.33%) lost 2 lines or more on Snellen chart.

We did not observe other serious complications such as bleeding, hyphema, inflammation or conjunctival burns.

DISCUSSION

Cyclodestructive procedures reduce intraocular pressure by damaging ciliary body processes. They are indicated for all types of glaucoma, especially for refractory glaucoma. We treated patients with different types of glaucomatous neuropathy, mainly with SOAG (almost 71%). Patients had uncontrolled glaucoma despite maximal topical therapy and oral medications.

According to literature, patients can reach normalization of IOP (a target IOP less than 22 mmHg) after CW-TSCPC

low-up. Notably, oral carbonic anhydrase inhibitor was reduced in almost all cases – only 2 patients waiting for another reoperation in 6-months follow-up had oral acetazolamide prescribed again.

Some studies have shown safety of CW-TSCPC [8, 9]. Postoperative complications including pain during and after surgery, conjunctival burns, uveitis, increase of IOP or hypotony, vision decreases or even vision loss are also described. However, cataract formation and glaucomatous neuropathy progression should be taken into account in assessment of BCVA deterioration [3].

In some reports CW-TSCPC can be useful for patients with good vision with good results. Ghosh et al. found that 39.1% of eyes retained their preoperative VA (> 20/60), 24% had a loss of two lines or more and 10.9% experienced some improvement in VA after 2 years of follow up [9]. Rotchford et al. also evaluated the effects of CW-TSCPC in patients with good visual acuity (≥ 20/60) in 5 years follow-up. They reported 67% of eyes retained VA of 20/60 or

better [8]. We also treated eyes having BCVA 0.3 or better (15 eyes), with medium results. 2 patient (13,3%) presented VA improvement, 4 patients (26.67%) retained their pre-operative VA, 9 of the patients (60%) lost at least 1 line on Snellen chart, and 5 of them (33%) lost 2 lines or more on Snellen chart.

In literature, retreatment range from 20% to 60% and has been most often described in younger patients, posttraumatic cases, and patients with secondary glaucoma following vitreoretinal surgery [4, 8, 10]. We obtained a low percentage of reoperation (4, 6 and 7 patients respectively

in 1, 2 and 6 months follow-up). We did not observe other serious complications. Main complains were peri- and postoperative pain, well-controlled with analgesics.

CONCLUSIONS

CW-TSCPC is technically easy, safe and effective procedure to control IOP in all types of refractory glaucoma in 6 months follow-up. CW-TSCPC is a satisfactory method which enables reduction of postoperative drugs intake, particularly oral acetazolamide intake.

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References

1. Anand N, Klug E, Nirappel A et al. A Review of Cyclodestructive Procedures for the Treatment of Glaucoma. *Semin Ophthalmol*. 2020; 35(5-6): 261-75. <http://doi.org/10.1080/08820538.2020.1810711>.
2. Spaeth GL, Danesh-Meyer HV, Goldberg I et al. *Chirurgia okulistyczna*. Elsevier 2012: 335-43.
3. Beardsley R, Law SK, Caprioli J et al. Comparison of Outcomes between Endoscopic and Transscleral Cyclophotocoagulation. *Vision (Basel)*. 2017; 1(4): 24. <http://doi.org/10.3390/vision1040024>.
4. Ndulue J, Rahmatnejad K, Sanvicente C et al. Evolution of Cyclophotocoagulation. *J Ophthalmic Vis Res*. 2018; 13(1): 55-61. <http://doi.org/10.4103/jovr.jovr>.
5. Frezzotti P, Mittica V, Martone G et al. Longterm follow-up of diode laser transscleral cyclophotocoagulation in the treatment of refractory glaucoma. *Acta Ophthalmol*. 2010; 88(1): 150-5. <http://doi.org/10.1111/j.1755-3768.2008.01354.x>.
6. Murphy C, Burnett C, Spry P et al. A two centre study of the dose-response relation for transscleral diode laser cyclophotocoagulation in refractory glaucoma. *Br J Ophthalmol*. 2003; 87(10): 1252-7. <http://doi.org/10.1136/bjo.87.10.1252>.
7. Vernon S, Koppens J, Menon J et al. Diode laser cycloablation in adult glaucoma: long-term results of a standard protocol and review of current literature. *Clin Exp Ophthalmol*. 2006; 34(5): 411-20. <http://doi.org/10.1111/j.1442-9071.2006.01241.x>.
8. Rotchford AP, Jayasawal R, Madhusudhan S et al. Transscleral diode laser cycloablation in patients with good vision. *Br J Ophthalmol*. 2010; 94(9): 1180-3. <http://doi.org/10.1136/bjo.2008.145565>.
9. Ghosh S, Manvikar S, Ray-Chaudhuri N et al. Efficacy of transscleral diode laser cyclophotocoagulation in patients with good visual acuity. *Eur J Ophthalmol*. 2014; 24(3): 375-81. <http://doi.org/10.5301/ejo.5000389>.
10. Pucci V, Tappainer F, Borin S et al. Long-term follow-up after transscleral diode laser photocoagulation in refractory glaucoma. *Ophthalmologica*. 2003; 217: 279-83. <http://doi.org/10.1159/000070635>.

Authors' contributions:

All authors discussed the results and have equal contribution to the final manuscript.

Conflict of interest:

None.

Financial support:

None.

Ethics:

The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals.