Efficacy of Transscleral Diode Laser Cyclophotocoagulation in the Treatment of Refractory Glaucoma: A Retrospective Study

Duygu AKBULUT SAGALTICI[1], Esin BASER[2]

ABSTRACT

Purpose: It was aimed to determine the efficacy of transscleral diode laser cyclophotocoagulation (TDLCP) in refractory glaucoma.

Materials and Methods: We retrospectively reviewed files of patients underwent TDLCP procedures at Eye Clinic of Celal Bayar University Hospital between January 2010 and December 2014. Overall, 41 eyes of 41 patients (21 right, 20 left eyes) with refractory glaucoma were included in the study. Intraocular pressure (IOP) before and after treatment, visual acuity, the number of medications and complications were analyzed.

Results: Twenty-one (48.7%) of the cases were female. Mean age was 49.6±22.02 years (range 6-87 years). Mean follow-up was 15.07±5.36 months (range 12-36 months). Mean IOP was 37.65±11.22 mmHg before treatment and 24.87±11.20 mmHg at last follow-up ($p<0.001$). In 70.7% of the cases, efficacy was achieved with single session of TDLCP, and the mean number of treatment was 1.36. Mean IOP shows a reduction by 53.6% at 1 week and by 33.9% at last follow-up. IOP of ≤22 mmHg was recorded in 48.8% of eyes at the last follow-up visit. Mean number of anti-glaucoma drugs was 3.68±0.72 before TDLCP and 3±0.89 at last follow-up ($p<0.001$). Pre-treatment the use of acetazolamide rate was 41.5% and 7.3% at last follow-up was ($p<0.001$). Hyphema was developed in 2 cases whereas phthisis bulbi in one and hypotonia in 3 cases.

Conclusion: TDLCP is an effective procedure with significant and long-term IOP reduction in refractory glaucoma. Therewithal, it provides a significant reduction in the use of both topical and oral anti-glaucoma drugs.

Key Words: Glaucoma, Intraocular pressure, Diode laser cyclophotocoagulation.

INTRODUCTION

Glaucoma is a progressive optic neuropathy characterized by cupping at optic nerve head, progressive retinal nerve fibre damage and ganglion cell loss, which causes characteristic loss of visual field. It is second most common cause of blindness worldwide.[1] Intraocular pressure (IOP) elevation is the major, known risk factor for glaucoma-related damage.[2] Thus, glaucoma management aims to decrease IOP at level targeted. In cases with glaucoma refractory to medical and surgical treatment, poor visual acuity as well as ocular pain and redness have negative influences on quality of life.

Transscleral diode laser cyclophotocoagulation (TDLCP) is used to reduce IOP and improve quality of life in patients with refractory glaucoma. TDLCP decreases humor aqueous release by causing damage in ciliary body.[3-5] In this method, semi-conductive laser energy at 810 nm is selectively absorbed by ciliary pigment epithelium, resulting in damage in ciliary body. In the literature, success rate for TDLCP has been reported as 35-85%.[6]

In our study, it was aimed to assess the efficacy of transscleral diode laser cyclophotocoagulation in IOP reduction in patients with glaucoma refractory to medical and surgical treatment.

MATERIAL AND METHOD

We retrospectively reviewed patients underwent TDLCP procedures at Glaucoma Unit of Eye Clinic of Celal Bayar

1- MD, University of Health Sciences, Bagcilar Research and Training Hospital, Department of Ophthalmology, Istanbul, Turkey

2- MD, Prof.,Karsiyaka Eye Hospital, Izmir, Turkey

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Correspondence Adress:
Duygu AKBULUT SAGALTICI
University of Health Sciences, Bagcilar Research and Training Hospital,
Department of Ophthalmology, 34200, Bagcilar, Istanbul, Turkey
Phone: +90 506 505 9477
E-mail: dr.duyguakbulut@gmail.com

University Hospital between January 2010 and December 2014. The study included glaucoma patients with IOP which could not be controlled with medical treatment (IOP≤22 mmHg despite maximum medical treatment), those failed in previous filtering or drainage surgery or those having general health status which did not allow glaucoma surgery, those with pain due to elevated IOP and refractory glaucoma patients with no potential vision. Data regarding diagnosis, demographic characteristics, pre- and post-TDLCP IOP values, number of anti-glaucoma drugs used before and after TDLCP, oral acetazolamide use, number of TDLCP sessions, number of pulses and presence of pop sound during procedure, visual acuity and complications were extracted from patient files. Acetazolamide was not given to pediatric patients with congenital glaucoma, diabetic patients with renal failure, those with history of renal stone disease and those could not tolerate oral acetazolamide, particularly those aged>80 years.

Cyclophotocoagulation was performed at operating room under peribulbar anesthesia (lidocaine 2% and bupivacaine 0.5%) in adult patients and under general anesthesia in pediatric patients by placing an eyelid speculum. Laser energy (810 nm) was applies via transscleral route by Oculight SL semi-conductive diode laser system using fiberoptic G probe (IRIS Medical Instruments Inc., Mountainview, CA, USA). All probes were cleansed with isopropyl alcohol 70% and sterilized using ethylene oxide after every procedure. The probe was not used after fifth application. The anterior margin of G probe was placed to border of limbus, positioning center of probe 1.2 mm beneath limbus in order to focus probe center over pars plicate of ciliary body. Initial laser settings were 1500 mW of power and 1500 msec of duration, which was gradually increased by 250 unit increments (maximum 2000 mW and 2000 msec) until pop sound indicating tissue destruction. After detection of pop sound, energy level returned to previous level and laser application was completed at this energy level. If no pop sound was detected, laser application was completed at maximal settings (2000 mW and 2000 msec). In one session, overall 15-20 pulses were applied as being 5-6 pulses at each quadrant. Absence or presence of pop sound was recorded in all patients. The laser therapy was given to an area of 270 degrees by preserving 3 and 9 o'clock directions where long ciliary arteries are located; in patients with history of glaucoma surgery, area of previous surgery was preserved and laser therapy was given to an area of 180 degrees. After laser therapy, topical steroid (eye drop, 8x1 over one week) and topical cycloplegic agent (eye drop, 3x1 over one week) were prescribed to patients. Topical steroid agent was gradually tapered. Patients continued anti-glaucoma therapy used before TDLCP. Control visits were scheduled on week 1 and at months 1, 3, 6, and 12. The final IOP measurement between 6 and 22 mmHg (with or without medication) were considered as successful. In addition, the decline in number of anti-glaucoma medication was also considered. Hypotonia was defined as IOP≤5 mmHg.

Data were analyzed SPPS version 18.0 (SPSS for Windows, version 18.0, SPSS, Chicago, IL, USA). Continuous variables are presented as descriptive statistics including mean, standard deviation, minimum and maximum while categorical variables are presented as count and percent. Paired samples t test was used to compare pre- and post-TDLCP IOP values. A p value<0.05 was considered as statistically significant. Wilcoxon sign rank test was used to compare number of anti-glaucoma medication used before and after TDLCP. A p value<0.05 was considered as statistically significant.

RESULTS

The study included 41 eyes of 41 patients (21 right eyes, 20 left eyes). There were 21 women and 20 men in the study population. Mean age was 49.6±22.02 years (range 6-87 years). Mean follow-up was 15.07±5.36 months (range 12-36 months). In the patients underwent TDLCP, there was neovascular glaucoma in 12 patients (29.3%), primary open angle glaucoma in 7 patients (17.1%), pseudoexfoliation glaucoma in 5 patients (12.1%), congenital glaucoma in 4 patients (9.8%), aphakic glaucoma in 4 patients (9.8%), angle closure glaucoma in 3 patients (7.3%), secondary glaucoma in 2 patients (4.9%), uveitic glaucoma in 2 patients (4.9%), silicone glaucoma in one patient (2.4%) and angle recession glaucoma in one patient (2.4%) (Table 1).

During follow-up, 29 cases (70.7%) received single session of TDLCP while 10 cases (24.4%) received 2 sessions, one case (2.4%) received 3 sessions and one case (2.4%) received 4 sessions of TDLCP. The patient received 4 sessions of TDLCP had uveitic glaucoma while the patient received 3 sessions had aphakic glaucoma. Mean number of treatments was 1.36±0.66 in 41 cases. The TDLCP was applied under local anesthesia in 29 cases (70.7%) while under general anesthesia in 12 cases (29.3%) (Table 1).

Mean IOP was 37.65±11.22 mmHg before treatment whereas 17.43±9.71 mmHg (p<0.001) on week 1, 22.51±8.76 mmHg (p<0.001) at month 1, 24.63±9.28 mmHg (p<0.001) at month 3, 25.85±11.22 mmHg (p<0.001) at month 6, 24.51±10.94 mmHg (p<0.001) at month 12 after treatment and 24.87±11.20 mmHg at last follow-up (p<0.001) (Table 2).

After TDLCP, no significant change was found in visual

Table 1. *Demographic and clinical characteristics of patients (n=41).*		
	n (%)	Mean±SD (Range)
Gender		
Female	21(48.7)	
Male	20(51.3)	
Mean age, years		49.6±22.02 (6-87)
Mean follow-up, months		15.07±5.36 (12-36)
Diagnosis		
Neovascular glaucoma	12(29.3)	
Primary open angle glaucoma	7(17.1)	
Pseudoexfoliation glaucoma	5(12.1)	
Congenital glaucoma	4(9.8)	
Primary angle closure glaucoma	4(9.8)	
Secondary glaucoma	3(7.3)	
Uveitic glaucoma	2(4.9)	
Silicone oil glaucoma	2(4.9)	
Secondary angle closure glaucoma	1(2.4)	
Eye		
Left	20(48.8)	
Right	21(51.2)	
Anesthesia		
Local	29(70.7)	
General	12(29.3)	
Number of TDLCP sessions		1.36±0.66 (1-4)
1	29(70.7)	
2	10(24.4)	
3	1(2.4)	
4	1(2.4)	
POP sound		
-	18(43.9)	
+	23(56.1)	
TDLCP: transscleral diode laser cyclophotocoagulation		

Table 2. *Change in intraocular pressure over time.*							
	Pretreatment	**Week 1**	**Month 1**	**Month 3**	**Month 6**	**Month 12**	**Last follow-up**
Mean IOP (mmHg)	37.65 ±11.22	17.43±9.71	22.51±8.76	24.63±9.28	25.85±11.22	24.51±10.94	24.87±11.20
Mean IOP reduction (mmHg)		20.21	15.14	13.02	11.80	13.14	12.78
% IOP change		53.67	40.21	34.58	31.34	34.90	33.94
P value		p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Dependent sample t test; Wilcoxon signed rank test; IOP: Intraocular pressure.							

acuity in 30 cases (73.1%) whereas there was no patient with improvement in visual acuity. There was 1-order decline in 2 patients (4.9%), ≥-orders decline in 7 patients (17.1%) and loss of light perception in 2 patients (4.9%). Hyphema was developed in 2 cases (4.9%) whereas phthisis bulbi in one (2.4%) and hypotonia in 3 cases (7.3%) (Table 3).

Before TDLCP, 17 patients (41.5%) were using oral acetazolamide while this figure decreased to 3 patients (7.3%) after TDLCP (p<0.001). Mean number of anti-glaucoma drugs was 3.68±0.72 before TDLCP, which was decreased to 3±0.89 (0-4) after TDLCP (Table 4).

DISCUSSION

TDLCP has long been used in the management of patients with refractory glaucoma, and remains to be an effective treatment modality.[7] In our study, TDLCP was found to effective in decreasing IOP; the mean IOP level was 37 mmHg before TDLCP while it was decreased to 24 mmHg

Table 3. *Complications and change in visual acuity after TDLCP (n=41).*

	n (%)
Complications	
Hyphema	2 (4.9)
Hypotonia	3 (7.3)
Phthisis bulbi	1 (2,4)
Visual acuity change	
Visual acuity gain	0
No change	30 (73.1)
1order loss a (Snellen chart)	2 (4.9)
≥2 order loss a (Snellen chart)	7 (17.1)
Loss of light perception	2 (4.9)

TDLCP: transscleral diode laser cyclophotocoagulation.

Table 4. *Changes in topical anti-glaucoma agents and oral acetazolamide use.*

	Topical anti-glaucoma agents (mean±SD)	Acetazolamide use n (%)
Before TDLCP	3.68±0.72	17(41.5)
After TDLCP	3±0.89	3(7.3)
P value	p<0.001[a]	p<0.001[b]

[a:] Wilcoxon signed rank test; [b:] McNemar test

TDLCP: transscleral diode laser cyclophotocoagulation

after treatment and IOP was ≤22 mmHg in 48.8% of patients at last follow-up. Although lacking of an universally defined success criteria for TDLCP makes it difficult to compare TDLCP studies, majority of studies in the literature used success definition of IOP level<22 mmHg as similar to our study.[8] In the literature, there are a few important reviews regarding effectiveness of TDLCP in glaucoma treatment. First review was conducted by American Ophthalmology Academy. In the review, 19 of 130 trials published during 1968 and 2000 were found to be eligible. The review reported success rate ranging from 70% to 81%.[9] In the second review, 22 trials published between 2000 and 2010; TDLCP success rate was found as 37-95% among studies defined success as IOP <21 or <22 mmHg.[10] Third review included manuscripts published between 2008 and 2017, reporting success rate ranged from 61% and 87%[8] In studies from Turkey, success rate was reported as 40.5% ,[11] 75%,[12] 74.3%[13] and 75.6%.[14] Success rate of 48.8% in our study seemed to be consistent with literature. It is though that wide range of success rate in the literature might be due to patient characteristics such as pretreatment IOP level, types of refractory glaucoma, previous history of surgery and pigmentation,[10] lack of universal definition for success[8] and methodological differences among studies.[9]

In our study, single session TDLCP was effective in 70.7% of patients and mean number of treatments was 1.36. It was reported that more than one session of TDLCP may be needed in refractory glaucoma cases with rates ranging from 0% to 56%.[10] In a study from Turkey, sufficient IOP reduction was achieved by single TDLCP session in 64.8% of cases; however, multiple sessions were needed in 35.2% of patients.[11] In another study on 92 eyes, mean number of treatments was 1.27 with a success rate of 48%.[15]

In our study, there was no change in visual acuity in 73.1% of cases after TDLCP; however, no case showed improvement in visual acuity. In previous studies, visual acuity loss was reported by 5-47%.[16] In clinical practice, many surgeons consider TDLCP as a treatment modality that would be used in advanced, refractory glaucoma or in cases where surgical intervention is impossible.[10] Thus, it is difficult to discuss effects of TDLCP on visual acuity. Although it has been accepted that TDLCP has no direct influence on visual acuity and that visual acuity loss results from progression of glaucoma.[11,17] It reported found that visual acuity loss primarily developed during first 6 months; thus, the likelihood treatment itself might account for loss at least in part could not be ruled out completely, indicating an issue requiring further investigation.[18] However, majority of studies in the literature including our study were retrospective in nature; thus, it is challenging to draw definitive conclusions regarding visual acuity. In addition to retrospective design, lack of systematic visual acuity recordings, lack of data about ocular or systemic diseases or conditions that may cause of loss visual acuity and focusing on IOP due to study populations including refractory glaucoma are other factors that make it difficult to assess visual acuity. In our study, hyphema was detected in 2 cases (4.9%) whereas phthisis bulbi in one (2.4%) and hypotonia in 3 cases (7.3%); our complication rates were in agreement with literature. It was reported that hypotonia occurred by 0-25% after TDLCP[11-20] while phthisis bulbi by 0-0.9%[10] and hyphema by 18%.[17] By studies in last decade, it was emphasized that micro-pulse transscleral cyclophotocoagulation technique which is more selective for ciliary body with less effect on surrounding tissue have similar efficacy with TDLCP method with lower complication rate.[21]

The finding of reduction in both topical and oral anti-glaucoma agents in refractory glaucoma cases after TDLCP has been consistently reported in the literature and is an important finding which improves quality of life in these patients.[11,17] In agreement with literature, a significant reduction was detected in both topical and oral anti-glaucomatous agent use in our study.

This study has some limitations including retrospective design and lack of a control group. These limitations make it difficult to assess effectiveness of TDLCP.

In conclusion, our results demonstrated a significant and long-term IOP reduction after TDLCP in cases with refractory glaucoma. In addition, a decrease in both topical and oral anti-glaucoma agents in refractory glaucoma cases after TDLCP was observed. Based on our results, it can be suggested that TDLCP is an effective and safe modality with potential to improve quality of life. Given our results and literature data, there is a need for well-designed, long-term, prospective studies with larger sample size and those comparing with micro-pulse transscleral cyclophotocoagulation in order to evaluate effectiveness and complications of TDLCP and factors affecting effectiveness.

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