Outcomes of Short and Long Duration Burns of Transscleral Diode Cyclophotocoagulation: A Retrospective Study

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ABSTRACT

Introduction: Transscleral cyclo-photocoagulation (TSCPC) is a cyclo-destructive procedure which targets the secretory epithelium of the ciliary epithelium and applicable to reduce intraocular pressure.

Objective: To compare the outcomes of transscleral diode cyclo-photocoagulation using short-duration (SD) versus long-duration (LD) burn treatment in ASEAN brown iris patients.

Methods: We analysed retrospective data from twenty-five eyes with glaucoma cases of any type who underwent cyclo-photocoagulation with SD (2000 ms) with variable power of ≤ 2000 mW versus LD (4000 ms) treatment with variable power ≤ 1200 mW. The intraocular pressure (IOP) and the number of antiglaucoma eyedrops reduction, visual acuity changes, and complications between the two techniques were documented.

Results: The mean IOP before treatment was 47.2 (8.4) mmHg and 30.15 (7.7) mmHg for SD and LD group respectively. At the final visit post-treatment, there was a reduction of IOP in both groups having 28.0 mmHg in SD ($p > 0.05$) and 22.15 mmHg in the LD ($p < 0.05$), respectively from pre-treatment. The mean number of eye drops before treatment was 3.6 for the SD group and 3.9 for the LD group. Post-treatment, it dropped to 1.4 for SD group ($p > 0.05$) and 1.8 for the LD group ($p > 0.05$). The mean logMAR visual acuity before treatment was 2.46 (SD) and 2.10 (LD) and at the post-treatment, the mean logMAR was 2.70 (SD) and 2.10 (LD) ($p > 0.05$). Both treatments resulted in complications such as inflammation, hypotony and hyphaema.

Conclusion: Both treatments reduced the intraocular pressure, and the number of antiglaucoma eye drops needed in ASEAN brown iris glaucoma patient. Comparatively, complications such as inflammation, hypotony and hyphaema were more in the LD group.

Key Words: Cyclophotocoagulation, Glaucoma, Intraocular pressure

INTRODUCTION

Transscleral cyclo-photocoagulation (TSCPC) is a cyclo-destructive procedure. It targets the secretory epithelium of the ciliary epithelium, which subsequently causes a reduction in the aqueous humour production and lowers the intraocular pressure (IOP). It is a semi-conductor solid-state diode laser system (810 nm wavelength) with a handpiece that is used to deliver laser energy.¹ TSCPC is usually reserved for managing uncontrolled intraocular pressure (IOP) in eyes with poor visual potential.² It is beneficial for pain relief in a blind glaucomatous eye^{3,4}, refractory glaucoma^{5,6}, secondary and complex glaucoma patients⁷ or patients who refused invasive surgery. Some chose conventional trabeculectomy with or

without cataract surgery to control IOP.⁸ Nevertheless, critical eye care is important for post-surgery quality.⁹

Both short and long duration has been postulated to be effective in lowering the IOP. Standard, 2000ms short duration was applied for dark iris colour with power titrated according to occasional 'pop'.¹⁰ Meanwhile, the no-pop technique or better known as slow coagulation described by Gaasterland is to use the longer duration of 4000ms in brown iris colour patient.¹¹ Some studies suggested that longer duration of TSCPC is more effective compared to shorter duration of TSCPC, especially in the eye with more pigment.^{11,12} The rationale behind is longer burns and lower power help reducing tissue destruction and inflammation outside the ciliary

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body which in turn leads to better control of IOP.

In this context, our study is aimed to investigate the effectiveness and safety of long duration TSCPC (longer duration with less power, 4000 ms with variable power of less than 1200 mW) and standard-setting of short duration (short duration with a higher power, 2000 ms with variable power of less than 2000 mW) in our ASEAN brown iris patients.

MATERIALS AND METHODS

Setting

It was a retrospective clinical study conducted in Sarawak General Hospital (SGH) from December 2017 until January 2019. The patients with refractory glaucoma of any type with guarded visual prognosis within the selected time frame were included in this study. However, we excluded incomplete data and paediatric patients aged less than 13 years.

Data and Variables

Demographic and clinical data at presentation were collected. We collected data on age, sex and race of the patients, the pre-operative visual acuity (VA), IOP and number of antiglaucoma medications used. The logarithm of the minimum angle of resolution (logMAR) was tabulated after conversion from Snellen visual acuity¹³. Postoperative data include IOP during follow-ups and complications such as prolonged inflammation, hypotony, hyphaema, cataract formation, cystoid macula oedema, pthysis bulbi, neurotrophic cornea and sympathetic ophthalmia. Prolonged inflammation was defined as any degree of cell or flare which was reported to persist after 1 month of surgery. We also included patients who failed to taper topical steroids or noted to have an increase in topical steroid usage during follow up as prolonged inflammation. An IOP of less than 6mmHg was defined as hypotony.

Laser Procedure

Iridex diode laser machine (OcuLight SLx, IRIS Medical Inc, Mountain View, CA) with a wavelength of 810 nm was used for the treatment of all cases. The procedure was done at the operating theatre (OT) under a sterile method by a single surgeon. An Iridex G-probe was used to deliver laser energy at the eye limbus of 180 to 270 degrees and sparing the 3 and 9 o'clock. Variable power was adjusted according to the 'pop' sound. Topical (proparacaine hydrochloride 0.5%) and peribulbar anaesthesia (Ropivacaine hydrochloride 0.75%) were given as local anaesthesia before the procedure. The short duration was defined as settings with variable power of ≤ 2000 mW and a duration of 2000 ms. Meanwhile, for a long duration, the setting was with the power of ≤ 1200 mW and a duration of 4000 ms.

Data Analysis

Data were analysed using IBM SPSS version 22.0 (IBM). Before the statistical test, an exploratory data analysis was done to find incomplete and missing data. The grossly incomplete data were discarded from the final analysis. We utilized the Wilcoxon signed-rank test to compare between pretreatment and posttreatment data. A p-value of ≤ 0.05 was used to determine statistical significance.

Ethical Issues

The study is registered with the National Medical Research Registry (NMRR). The research was operated according to the Declaration of Helsinki. Informed written consent was acquired from the patients before surgical procedure and data collection. The patients were assured of data confidentiality and privacy.

RESULTS

Characteristics of the Patients

Initially, a total of forty patients underwent TSCPC during the 14 months duration. Fifteen patients had incomplete records and not traceable data. These were excluded from the study. Finally, 25 eyes with completed data were included for analysis. All procedures were done by a single glaucoma surgeon. Out of the 25 patients, 18 were male (72%) and 7 were female (28%). Most of the patients were in the age group of 41 to 60 (40%) and 61 to 80 (40%). There were 5 patients (25%) in the short-duration group and the remaining 20 patients (75%) were in the long duration group. The TSCPC was done almost equally over both eyes (a total of 12 times over the right eye and 13 times over the left eye) (Table 1). Majority of the procedures done under local anaesthesia with only one case done under general anaesthesia due to young age.

Clinical Outcomes

Intraocular pressure

In the short-duration group, the intraocular pressure decreased from 47.2 ± 8.4 mmHg to 28.0 ± 27.8 mmHg, but the reduction was not statistically significant ($p > 0.05$). While in the long-duration group, it decreased from 30.15 ± 7.7 mmHg to 22.15 ± 10.5 mmHg and the reduction was statistically significant ($p < 0.05$) (Table 2).

The IOP decreased in both groups of patients following procedure. The IOP remained the same and did not significantly change over time ($p > 0.05$) in both groups. However, no statistically significant mean difference ($p > 0.05$) was found between SD and LD over the time except pre-operative IOP

($p < 0.05$), in which mean(sd) IOP for SD was 47.20(8.35) mmHg and that of LD was 30.15(7.71) mmHg (Figure 1).

The number of anti-glaucoma eyedrops

There was also a decrease in the number of antiglaucoma eyes drops, as seen in the short-duration group (from 3.6 to 1.4) and LD group (from 3.9 to 1.8), but both reduction was not statistically significant ($p > 0.05$) (Table 2).

Visual acuity

In the SD group, there was a drop in VA from logMAR 2.46 to 2.7 ($p > 0.05$). Whereas, in the LD group, the logMAR VA remained the same as pre and post-treatment (2.1 logMAR) (Table 2).

Complications

Postoperative complications such as prolonged inflammation, hypotony, hyphaema were seen more in the LD group in this study. Prolonged inflammation was seen in the LD group (a total of 5 patients; 25%) while none was documented in the SD group. Hypotony was observed in 2 patients in the LD group (10%) and 2 in the SD group (40%). Only two patients were reported to have hyphaema in the LD group (10%), while none in the SD group (Figure 2). Other complications such as cataract, phthisis bulbi, cystoid macula oedema, neurotrophic cornea and sympathetic ophthalmia were not documented in both groups.

DISCUSSION

The use of semiconductor diode laser transscleral cyclophotocoagulation to control intraocular pressure in glaucoma patients was reported as early as 1992.¹⁰ The short-duration cyclo-diode is traditionally used with a laser setting of two-second duration and variable power adjusted according to audible 'pop' is heard by the surgeon. The newer long-duration cyclo-diode is using slow coagulation protocol, four-second duration and power reduced to 1.50W. The longer burns and lower power are believed to have the more lateral distribution of thermal energy causing more widespread damage to ciliary epithelium which in turn leads to better control of IOP.^{11,12}

From our results, we found that both the SD and LD reduced the IOP. This is supported by the previous studies.^{12,15,16} Although the IOP decreased clinically for both groups, the reduction was statistically significant in the LD group. This might be due to the small sample size in the SD group compared to the LD group in our study. The sudden increase in IOP after transscleral cyclo-photocoagulation needs to be addressed because it poses a risk to advanced glaucoma causing ischemia-perfusion retinal injury, optic nerve damage and central retinal artery occlusion.¹⁷ Nevertheless, this IOP

spike was not seen in our study during follow up. Most of the studies claimed that both SD and LD showed a reduction in the number of antiglaucoma eye drops.^{12,16,18} which is consistent with our analysis. This effectively reduces the burden of frequent eye drops installation and subsequently improves the quality of life. Most of the subjects recruited in this study have rather a poor baseline VA as compare to other studies which had better pretreatment VA.⁸ The progressive disease of glaucoma and the effect in visual acuity is likely to play a role in the poor VA. We did not see a significant change in the visual acuity post-treatment.¹²⁻¹⁴

Complications are seen in post-treatment of cyclo-diode laser.¹⁸⁻²¹ Comparatively, the complications were more in the LD group from the present study. This is likely due to the discrepancy between the number of subjects in both groups in our study. The significant greater degree of inflammation in the LD group (25%) suggests that lower power and longer duration burns may result in greater ciliary body inflammation in the early postoperative period.¹² However, with steroid therapy, the degree of inflammation was controlled during subsequent clinic follow-ups. Duerr et al.²² in their study reported that slow coagulation group or long-duration burn had lower postoperative prolonged inflammation when compared to short-duration group.²² Other complications such as hypotony and hyphaema were seen as well. Hypotony was found relatively higher at the SD group. Nevertheless, post-treatment complications of cataract, phthisis bulbi, cystoid macula oedema, neurotrophic cornea and sympathetic ophthalmia were not seen in our study.

There were some limitations in this study that needs to be highlighted. Firstly, due to the small sample size, we could not draw substantial evidence. We used only less powerful non-parametric analysis. Secondly, some of the patients were under our treatment with short-duration and were discharged back to their nearest hospital for follow-up (post-treatment). Thirdly, there might be inter-observer variation due to different medical personnel performed the ocular examination. Further studies addressing these limitations may be worthwhile.¹⁵⁻¹⁷

CONCLUSION

The diode laser TSCPC of LD and SD offer the potentially significant effect in lowering IOP, and the number of antiglaucoma eye drops needed in ASEAN brown iris glaucoma patient. There was no significant change in the visual acuity post-treatment. Comparatively, complications such as inflammation, hypotony and hyphaema were more in the LD group.

List of Abbreviations

IOP	Intraocular pressure
LD	Long-duration
mmHg	Millimeter of mercury
OT	Operating theatre
SD	Short-duration
Sd	Standard deviation
TSCPC	Transscleral cyclophotocoagulation
VA	Visual acuity
ms	Mili-second
mW	Miliwatt

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Author's Contribution:

Kevin Kwan Joo Ern: Data collection, wrote the manuscript

Tham Zen Kuang: Data collection and designed the study

Md Mizanur Rahman: Performed statistical analysis and helped manuscript drafting

Lim Ching Wei: Surgeon performed the procedure, designed the study and drafted the manuscript

Ting Siew Leng: Designed the study, data analysis, and drafted the manuscript

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Table 1: Social demographic data

		N (%)	
		Short Duration	Long Duration
Number		5 (20%)	20 (80%)
Gender	Male	4 (16%)	14 (56%)
	Female	1 (4%)	6 (24%)
Laterality	Right	4 (16%)	8 (32%)
	Left	1 (4%)	12 (48%)
Mean age (Sd)		59.8 (4.0)	51.8 (16.0)

Table 2: Clinical outcome of pre and post-treatment

Parameters	n	Pre-treatment Mean $\pm$ Sd	Post-treatment Mean $\pm$ Sd	p-value
IOP				
Short-duration	20	47.2 $\pm$ 8.4 mmHg	28.0 $\pm$ 27.8mmHg	>0.05
Long-duration	5	30.15 $\pm$ 7.7 mmHg	22.15 $\pm$ 10.5mmHg	<0.05
Number of anti-glaucoma eyedrops				
Short-duration		3.6	1.4	>0.05
Long-duration		3.85	1.75	>0.05
Final VA in logMAR				
Short-duration		2.46	2.7	>0.05
Long-duration		2.1	2.1	>0.05

IOP= intraocular pressure, $p < 0.05$ significant (Wilcoxon test)

Figure 1: Estimated marginal means of IOP over time.

Figure 2: Incidence of different complications arising from red eye conditions.