

Effectiveness of trans-scleral cyclophotocoagulation for refractory paediatric glaucoma

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ABSTRACT

Background: Paediatric glaucoma is often difficult to treat. Aggressive inflammation and healing response in children often results in an unsuccessful filtration surgery. Ciliary body ablation is one option for the management of glaucoma which is refractory to medical and surgical treatments. Inflammatory and healing responses in children differ from those in adults. The aim of this study was to find out the effectiveness of trans-scleral cyclophotocoagulation in lowering intraocular pressure in the paediatric population managed at a public sector tertiary care referral center in Lahore.

Patients and methods: This quasi experimental study was conducted between July 2020 and January 2021 in Department of Ophthalmology, The Children's Hospital, Lahore. Total 45 eyes of 42 children of age 1-14 years, both genders, with glaucoma were enrolled in this study. Diode cyclophotocoagulation unit and probe of make Quantel Medical was used for cycloablation under general anesthesia. Postoperative intraocular pressure was noted by using handheld Perkins applanation tonometer Mk2 after every 3 weeks for 12 weeks. If an IOP of ≤ 21 mmHg was achieved, then efficacy or success was labeled. Patients with an IOP of >21 mmHg after 12 weeks were selected for repeat cycloablation treatment. Failure was labeled to an IOP of >21 mmHg even after a repeat session. Data analysis was done using SPSS 24. Paired sample t-test was applied to compare mean change in IOP level.

Results: In this study, 45 eyes were included with the mean age of 4.49 ± 3.12 years. There were 21 (46.7%) males and 24 (53.3%) females. At the time of presentation, the most common diagnosis was primary congenital glaucoma [28 (62.2%)], followed by aphakic glaucoma [10 (22%)], Anterior segment dysgenesis [2 (4.4%)], Pseudophakic glaucoma [2 (4.4%)], Sturge weber syndrome [2 (4.4%)] and Post-traumatic [1 (2.2%)]. The mean IOP at baseline was 26.67 ± 3.66 mmHg, which was reduced to 19.60 ± 6.33 mmHg with mean change in IOP of 7.07 ± 4.56 mmHg ($p < 0.05$). The mean anti-glaucoma drugs used at baseline was 2.91 ± 0.42 , which was reduced to 0.93 ± 1.2 with mean change in use of anti-glaucoma drugs of 1.98 ± 1.06 ($p < 0.05$). Success was achieved in 34 (75.56%) eyes, while 11 (24.44%) needed second session. After repeat session 2 (4.4%) eyes went into treatment failure.

Conclusion: Diode cyclophotocoagulation is a useful therapy for the management of glaucoma in children.

Keywords:

Diode cyclophotocoagulation, paediatric glaucoma, intraocular pressure, refractory

INTRODUCTION

Glaucoma management in children has always been challenging especially when it comes to secondary and advanced glaucoma.¹ Filtration surgery is often not successful and severe complications can result including hypotony particularly in buphthalmic eyes where the sclera is already thin. There is a 50% rate of transient perioperative complications post trabeculectomy as seen in Collaborative Initial Glaucoma Treatment Study and long term failure reported to be as high as 23% to 51% at 5 years and 52% to 59% at 15 years.² Moreover, the healing response in paediatric age group is aggressive which also favors against drainage surgery. In such cases

treatment is not only difficult but is rather associated with high risk of postoperative complications.

Ciliary body ablation is one option for the management of glaucoma which is refractory to medical and surgical treatment. Trans-scleral cyclophotocoagulation (TS-CPC) uses a continuous diode laser energy source.³ It employs an 810nm semiconductor diode laser, energy of which is absorbed by melanin in the ciliary epithelium. Resultant thermal energy destroys the ciliary body and its vascular supply. Thus reducing aqueous humor production and a lower intraocular pressure.⁴

Cyclophotocoagulation has been used as an alternative to filtration surgery in eyes with good visual potential.⁵ Other methods of cycloablation, like cyclocryotherapy and Nd:YAG laser photocoagulation, are associated with an increased incidence of complications compared to TS-CPC, for example

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phthisis bulbi, hypotony, uveitis, pain and loss of visual acuity.⁶ Recent studies show that TS-CPC is a minimally invasive procedure with a significant reduction in intraocular pressure especially in refractory cases of glaucoma.⁷ The advantage of fewer side effects and its portable nature make diode laser a better treatment option for glaucoma in children. Micropulse diode laser application is a newer treatment modality but is not yet freely available in local tertiary care hospitals.⁸

The aim of this study was to find out the effectiveness of TS-CPC in the paediatric population managed at a public sector tertiary care referral pediatric hospital in Lahore.

PATIENTS AND METHODS

The study was performed in Department of Paediatric Ophthalmology, The Children's Hospital and Institute of Child health, Lahore from July 2020 to January 2021 after the approval of the institutional review board and a written informed consent was obtained from parents/guardians. Total 45 eyes were included in the study by using 95% confidence level, 14% margin of error and percentage of success i.e. 66% after first session of TS-CPC. Patients fulfilling the inclusion criteria of primary congenital glaucoma and secondary glaucoma like aphakic glaucoma, sturge weber syndrome, post traumatic glaucoma not responding to medical and surgical treatment and painful blind eye with raised intraocular pressure were enrolled. Both genders between ages 1 and 14 years were included. Thorough history with details of all the medical and surgical treatments given to the patient was taken. Patients were admitted a day prior to the procedure and preoperative labs and anesthesia evaluation was done. In the operating theater under general anesthesia a lid speculum was placed in the eye to undergo TS-CPC. Position of the ciliary body was identified by transillumination. TS-CPC was performed using a fiber optic probe attached to a semiconductor laser unit of make Quantel Medical. Initial power was set at 2000mW and was increased in increments of 150milliwatts until a "pop" was heard. Duration was set at 80 seconds and diode laser was applied along 2 quadrants sparing 3 and 9 o'clock hours. Topical steroids were instilled postoperatively 4-8 times daily for 4-6 weeks. Patients were followed 1 day, 1 week, 3 weeks, 6 weeks and 12 weeks after the procedure. Hypotony was defined as intraocular pressure of ≤ 5 mmHg. Success was labeled when target intraocular pressure ≤ 21 mmHg was achieved after first session,

which was noted by handheld Perkins tonometer Mk2 of make Clement Clarke Ophthalmic. Patients with uncontrolled intraocular pressure i.e. ≥ 22 mmHg at 12 weeks were readmitted for repeat session. Reduction in number of different anti-glaucoma drugs patients was using before and after surgery was also noted. Statistical analysis of the data that is the IOP before and after the procedure at 3 weeks intervals for 12 weeks and the number of antiglaucoma drugs for example topical dorzolamide, timolol and latanoprost before and after the procedure was done using SPSS 24. The difference between IOP and number of medications before and after treatment were carried out by Paired sample t-test. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

In this study, 45 eyes were included with the mean age of 4.49 ± 3.12 years. There were 21 (46.7%) males and 24 (53.3%) females. At the time of presentation, the most common diagnosis was primary congenital glaucoma [28 (62.2%)], followed by aphakic [10 (22%)], anterior segment dysgenesis [2 (4.4%)], Pseudophakic glaucoma [2 (4.4%)], Sturge weber syndrome [2 (4.4%)] and post-traumatic glaucoma [1 (2.2%)] (Table 1).

The mean IOP at baseline was 26.67 ± 3.66 mmHg, which was reduced to 19.60 ± 6.33 mmHg with mean change in IOP of 7.07 ± 4.56 mmHg. There was a significant reduction in mean IOP after first session ($p < 0.05$). The mean anti-glaucoma drugs used at baseline was 2.91 ± 0.42 , which was reduced to 0.93 ± 1.2 with mean change in use of anti-glaucoma drugs of

Table 1. Baseline characteristics of patients

Characteristics	Frequency (%)
Age (years)	4.49 ± 3.12
Gender	
Male	21 (46.7%)
Female	24 (53.3%)
Diagnosis	
Anterior segment dysgenesis	2 (4.4%)
Aphakic glaucoma	10 (22.2%)
Primary congenital glaucoma	28 (62.2%)
Post-traumatic glaucoma	1 (2.2%)
Pseudophakic glaucoma	2 (4.4%)
Sturge weber syndrome	2 (4.4%)

Table 2. Outcome of procedure

Outcome	Preoperative	Postoperative	Change	p-value*
IOP	26.67 ± 3.66	19.60 ± 6.33	7.07 ± 4.56	0.000
Anti-glaucoma drugs	2.91 ± 0.42	0.93 ± 1.2	1.98 ± 1.06	0.000
0	0 (0.0%)	24 (53.3%)		0.000
1	0 (0.0%)	8 (17.8%)		0.000
2	6 (13.3%)	7 (15.6%)		0.000
3	37 (82.2%)	4 (8.9%)		0.000
4	2 (4.4%)	2 (4.4%)		0.000

*Paired sample t-test was applied

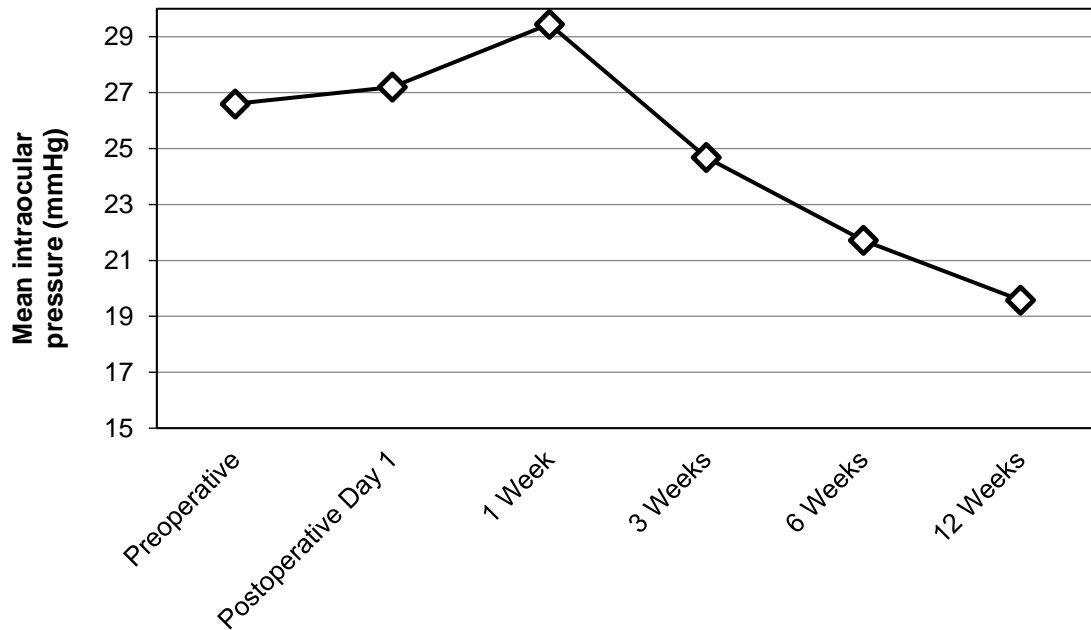


Figure 1. Change in IOP on every visit during follow-up after surgery

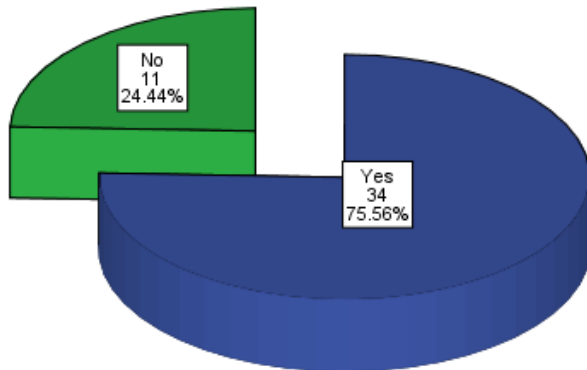


Figure 2. Target IOP achieved after surgery

1.98 ± 1.06 . This was significant reduction in mean reduction in use of anti-glaucoma drugs after first session ($p < 0.05$) (Table 2). Figure 1 shows trend in mean change in IOP level during follow-up after surgery.

Out of 45 cases, success (target blood pressure ≤ 21 mmHg) was achieved in 34 (75.56%) patients, while 11 (24.44%) patient needed second session. After repeat session 2 (4.4%) eyes went into treatment failure (Figure 2).

DISCUSSION

Glaucoma in childhood can be treated by various surgical procedures. Surgical management with either goniotomy or trabeculotomy is ideally the first choice of treatment in primary congenital glaucoma where

clarity of the cornea permits. Surgery is challenging and follow up over lifetime is demanding, including amblyopia prevention and examinations under anesthesia.⁹ Aqueous tube shunts and diode cycloablation should be reserved for refractory glaucoma. However, there are several barriers to the success of filtration surgery. The utilization of diode cyclophotocoagulation in achieving a gross reduction in intraocular pressure, despite its proven role is still not common because of its potential side effects like permanent hypotony and phthisis bulbi.⁴ In this study, cycloablation limited to merely 2 quadrants of ciliary body and satisfactory lowering of pressure after a single session was achieved.

In our trial, we observed that the mean change in IOP was noted from 26.67 ± 3.66 mmHg to 19.60 ± 6.33 mmHg (mean change = 7.07 ± 4.56 mmHg, $p < 0.05$). The mean change in anti-glaucoma drugs was noted from 2.91 ± 0.42 to 0.93 ± 1.2 (mean change = 1.98 ± 1.06 , $p < 0.05$). And we achieved success in 75.6% cases after first session of TS-CPC, while no side effects were noted after first session. In a study performed in a paediatric teaching hospital of Brno, the results show effective lowering of intraocular pressure in 79% of the eyes at 1 year and 63% at the end of 2 years with a mean of 2.1 treatment sessions per eye with TS-CPC.¹ In another study performed on both children and adults the success rate was 66.6% after the first laser treatment and 86.7% following repeat laser treatment.⁴

Current study is related to paediatric refractory glaucoma and results were similar to previous studies.^{4,8} A single session of diode cyclophotocoagulation resulted in IOP reduction by 25%. However 22% of the cases required a repeat session. One previous study showed a success rate of 66.7% with a single session at the end of one year.¹¹ Another study found that multiple repeat treatment sessions were required in younger patients. The authors attributed the need for repeat sessions to higher level of aqueous production and aggressive healing response in paediatric population.¹²

In another study, 3 quadrants of ciliary body were ablated with diode laser and 52% reduction in intraocular pressure was achieved.¹³ In present study the mean intraocular pressure reduction was 25% at the end of 3 months. Possible explanation for a limited extent of reduction may be due to a lesser extent of ciliary ablation i.e. 2 quadrants in our study as compared to 3 quadrants. It is recommended to ablate 2 quadrants in the 1st session so as to avoid intense inflammation and hypotony. One previous study described a direct relation between the total amount of energy and reduction in intraocular pressure.¹⁴ No association was found between energy and postoperative intraocular pressure in current study. However, there are no standardized values of the magnitude and extent of laser energy to be used during diode cycloablation.¹⁵

Limitations of current study are small sample size and a short follow up. However, its prospective nature is our strength. Long term follow up and further research regarding side effects and efficacy of the procedure is recommended.

CONCLUSION

Significant control of intraocular pressure can be achieved with 180 degrees of trans-scleral diode cyclophotocoagulation in paediatric patients with refractory glaucoma.

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