Outcome of Transscleral Cyclophotocoagulation in Refractory Glaucoma at a Tertiary Eye Hospital in India

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Abstract

Background: Transscleral cyclophotocoagulation (TSCPC) is a cyclodestructive procedure used to control elevated intra ocular pressure(IOP) in refractory glaucoma. We studied the efficacy and safety of TSCPC in refractory glaucoma at our hospital.

Method: Data was collected retrospectively from patients who underwent TSCPC over a two year period. Primary outcome measure was success in terms of IOP reduction and the secondary outcome measures were relief of symptoms and incidence of complications.

Results: 27 of 42 patients who underwent TSCPC were included for analysis which included 16 men and 11 women with mean age 61.8±13years and visual acuity ranging from 6/24 to no perception of light.

Mean IOP decreased from 46.0±8.6 mmHg(range: 26-58 mmHg) pre-procedure to 16.7±13.4 mmHg($p<0.001$) at last follow-up. Complete success was achieved in 22.2%, qualified success in 18.5%, 29.6% eyes had hypotony and 29.6% failed. Mean glaucoma medications decreased from 3.2±1.3 to 0.9±1.2($p<0.001$). Patients were asymptomatic; complications were phthisis and vitreous hemorrhage which resolved (one case each).

Conclusion: TSCPC is a safe and effective method of controlling IOP in refractory glaucoma. It may not be restricted to eyes with poor vision potential and a pain-free patient is often the end result.

Key Words: *Glaucoma, Cyclophotocoagulation, Lasers in glaucoma, Pain*

Introduction

Cyclodestructive procedures are used to manage glaucoma in refractory cases where conventional medical and surgical treatments are ineffective in controlling elevated intra ocular pressure(IOP).[1] It can be performed using β-irradiation, electrolysis, photocoagulation, cryotherapy, ultrasound or microwave cyclodestruction. Transscleral Cyclophotocoagulation(TSCPC) is one of the common cyclodestructive procedures in use today. It reduces the aqueous production by damaging the pars plicata, either by destruction of the ciliary epithelium or by reduced vascular perfusion. It may also increase the outflow through an effect on the pars plana.[2]

Many studies have shown that it is an effective method to control IOP in advanced, refractory glaucoma.[3,4,5,6,7,8,9] It has also been reported to have a role in glaucoma management in patients with good vision, with comparable visual outcomes to trabeculectomy or tube shunt surgery.[10] Recent literature suggests that

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cyclophotocoagulation is being performed increasingly as the primary surgery for various types and stages of glaucoma.[11,12] Nevertheless, cyclodestructive procedures carry the risk of serious complications like hypotony and visual loss.[13] Literature from the Indian subcontinent regarding TSCPC is limited and hence we studied the efficacy and safety of TSCPC in refractory glaucoma managed over a two year period at our hospital.[14,15,16]

Materials and Method

The retrospective, observational study was conducted at a tertiary eye hospital and included all patients who underwent TSCPC from January 2013 to August 2015. The Institutional Ethics Committee reviewed and approved the protocol prior to conducting the study.

All patients underwent a comprehensive eye examination and the decision to treat was based on presence of pain/symptoms, visual potential, elevated IOP on maximal tolerated medical therapy. Under peribulbar anaesthesia TSCPC(Oculight SLx, Iridex Corporation, Mountain View, CA) was performed using a G-probe(Iris Medical Instruments, Mountain View, CA, USA). The probe was placed adjacent to the corneoscleral limbus, power set at 1750mW for 2000ms and increased until a 'pop' was heard and adjusted to a sub-threshold level. 6-9 spots of laser were applied in each quadrant, with total spots ranging from 24-35.

Patients were examined on the next day, at one week, one month, three months and six monthly after that. At each follow-up, symptoms, vision, the anterior segment, IOP and posterior segment details were documented along with any change in treatment. Patients were excluded from analysis if the follow-up period was less than 3 months. All data was collected from the electronic medical records of the patients at the hospital.

Efficacy was evaluated in terms of IOP reduction, symptom relief and reduction in anti-glaucoma medication(AGM). Complete success was defined as IOP ≤21mmHg and ≥6mmHg without medication or additional treatment. Qualified success was defined as an IOP between 6-21mmHg with additional treatment. Hypotony was defined as IOP <6mmHg and failure as IOP>21mmHg. The safety was assessed in terms of complications that occurred during/after procedure.

Statistical analyses were done with Statistical Package for Social Sciences(SPSS 22) (IBM Corp. IBM NY, USA). Paired t-test was used for comparison of before and post-procedure IOP and AGM. p value <0.05 was taken as statistically significant. Numerical data was expressed in the form of mean±standard deviation when distribution of outcome variable was normal.

Table 1: Vision in the eyes that have undergone TSCPC

Pre-treatment Vision	Vision at last follow-up	Number of eyes
No PL	No PL	13
PL Present	No PL	3
	HM	1
HM	HM	2
	CFCF	1
CFCF	No PL	1
	CFCF	1
	Counting fingers at 3m	2
6/24	6/24	1
6/36	6/60	1
6/60	6/60	1

PL: Perception of light, HM: Hand movements, CFCF: Counting fingers close to face

Table 2: Reduction of IOP post TSCPC

Paired t-test comparing Pre procedure IOP with IOP on follow up	Mean reduction in IOP(mmHg)	Std.Deviation	95% Confidence Interval of the Difference		P value
			Lower	Upper	
First day	24.00	14.68	14.14	33.86	<0.001
First week	28.44	11.44	23.72	33.16	<0.001
First month	24.09	12.19	18.69	29.50	<0.001
Third month	20.55	14.29	13.86	27.23	<0.001
Sixth month	23.64	14.05	17.41	29.86	<0.001
One year	26.61	13.35	19.97	33.25	<0.001
Last visit	29.33	15.05	23.38	35.29	<0.001

Results

A total of 42 patients underwent TSCPC from January 2013 to August 2015. 27 eyes of 27 patients were included in this retrospective analysis of which 16 were men and 11 women. The remaining 15 were referred cases who followed up with their referring doctors. The mean age of patients was 61.81±12.98 years(range:18-74yrs). Visual acuity in the eyes undergoing TSCPC ranged from 6/24 to no perception of light. Ten eyes had vision better than or equal to Hand Movements(HM) and 17 had vision poorer than HM.(Table 1)

The indications for TSCPC included neovascular glaucoma(NVG) (18eyes), post vitreo-retinal surgeries(4), trauma(2), primary angle closure glaucoma(1), primary open angle glaucoma(POAG) (1) and uveitis(1). The median follow-up period was 16months(Q1= 10 months)

The mean IOP reduced from 46.0±8.6 mmHg(range:26-58 mmHg) to 16.7±13.4 mmHg (range:1-46 mmHg). This difference was significant statistically(P<0.001) in all postoperative intervals accounted for.(Table.2)

Complete success was achieved in six eyes(22.2%), qualified success in five eyes(18.5%), eight eyes had hypotony(29.6%), and eight failed to achieve IOP ≤21mmHg(29.6%). The mean IOP reduction from baseline was 63.7%. In 24 eyes(88.9%) IOP reduction was more than 30% of baseline IOP. Three eyes(11.1%) failed to get an IOP reduction of at least 30% from baseline.

The mean number of preoperative AGM was 3.2±1.3 which decreased to 0.9±1.2(p<0.001). Four eyes underwent a single repeat TSCPC. Pain was the most prominent symptom, others included redness, watering and diminution of vision. At last follow-up, all 27 patients were pain-free.

There was no statistically significant change in vision after TSCPC. In 66.7% the visual status remained stable, in 14.8% there was improvement and in 18.5% there was worsening of vision.(Table 1) The complications included phthisis of one eye and vitreous hemorrhage in one eye which resolved spontaneously.

Discussion

Management of refractory glaucoma can be challenging. The response to medications is poor, traditional surgery like trabeculectomy can fail and often the patients have intolerable symptoms. In our study we found that TSCPC reduced IOP significantly, with modest success, good reduction of AGM and pain relief.

Previous studies have noted effective IOP reduction by TSCPC in refractory glaucomas.[3,4,5,6,7] Osman and Frezzotti reported a success rates of 82.8% and 63.0% and Schlote described success of 44% in traumatic and aphakic glaucomas.[3,4,7] Our study too confirms this efficacy with mean reduction of IOP of 63.7%, but lower success rate due to larger number of eyes developing hypotony. Hypotony was most common in NVG, similar to report by Iliev.[8] Kaushik hypothesized that Asian eyes needed lower energy levels to reduce IOP, and even with a limited 180 degrees TSCPC, Bezci-Aygün found the procedure reasonably successful.[16,17] The large variation in the success rates among studies is explained by the variation in the etiologies and in the laser parameters. By tailoring the parameters to patient response, the results may be optimized.[18]

Even with a poor visual potential, intolerable pain compels the patients to undergo TSCPC.[5,6] In our study, all patients were pain-free on follow-up, even those in whom TSCPC failed. Pain relief could be because of damage to the sensory nerve supply of the anterior segment in addition to lower IOP.[4] Mistlberger and Schlote have taken pain relief as one of the indicators of success when vision was poorer than HM.[5,6] In our study, among the 16 unsuccessful eyes, 11 had pre-procedure vision poorer than HM. By redefining success in terms of pain relief, the success rate becomes 81.48%.

In the Indian subcontinent, Kaushik reported a reduction of AGM following TSCPC from 2.6±0.9 to 1.8±1.2, similar to our study.[16] Other reports around the world also show significant reduction of AGM.[8,11,23]

There was only one case of phthisis in our study and vision was stable in the majority, unlike earlier reports.[13,19] TSCPC is increasingly tried in patients with good vision potential and as primary treatment in glaucoma.[10,13] Shah found TSCPC effective in eyes with good visual potential, but 33% had a vision drop of ≥2lines due to iritis and cystoid macular oedema.[20] In a study by Ghosh, ≥2lines reduction in vision was seen in 23.9% cases but with a success rate of 84.8% and good safety.[10] Contrary to this, Bleisch found that the visual fields continued to worsen after cyclophotocoagulation and Hasan reported cyclophotocoagulation is less effective that trabeculectomy in POAG.[21,22] Abdull found TSCPC to be safe and effective in cases of primary glaucoma where regular follow-up is not critical.[12] Stanca described a 'slow-burn' technique which can be used in eyes with better vision.[23] These reports are not conclusive about suitability of TSCPC in eyes with good vision or POAG. In secondary glaucomas TSCPC still continues to play a significant role. In fact, Choy and colleagues have found that TSCPC fared better that tube surgery in NVG cases.[24]

High intensity focused ultrasound(HIFU), endocyclophotocoagulation(ECP) and micropulse TSCPC(MP-TSCPC) are newer cyclodestructive procedures.[25,26,27,28] Graber and colleagues have found HIFU to be safer but less effective than TSCPC(25% success versus 52%).[25] ECP is reported to be comparable to other treatments, in refractory glaucoma and pediatric glaucomas.[29,30] One disadvantage of ECP is that it is an invasive procedure.

Zaarour reported a success of 73.3% with MP-TSCPC and Subramaniam found it to be effective and repeatable in keratoplasty eyes with good graft survival.[31,32] Abdelrahman found MP-TSCPC to be better than TSCPC in pediatric refractory glaucomas.[33] MP-TSCPC is not devoid of complications; vision change, pain, corneal edema, hyphema, persistent hypotony, choroidal detachment and phthisis have all been reported.[34] The IOP reduction in MP-TSCPC is partly due to inflammation of the ciliary body and once it settles, IOP can potentially build up again.

In the era of emerging MP-TSCPC, the distinct advantage TSCPC has is that the G probe can be reused after ethylene oxide sterilization, even up to 30 sessions.[35,36] Rootman has devised a sterile disposable cover for G probes eliminating risk of contamination on reuse.[37] In contrast, the MP-TSCPC probe is not reusable making it a more expensive procedure. This advantage of TSCPC makes it indispensable in developing nations around the world.

A few patients who underwent TSCPC at our centre could not be included in the study due to inadequate follow-up. These patients had been referred to our institute for TSCPC and would follow-up elsewhere. Our study is limited by its retrospective nature and unequal follow-up periods among the patients.

Future studies can be conducted with grading of pain before and after. Studies where the laser is tailored to the patient or disease condition are necessary, to avoid hypotony complications. Further randomized controlled trials would be needed to establish the role of TSCPC in eyes with good visual potential or in cases of primary glaucomas.

Transscleral cyclophotocoagulation is an effective and safe method of controlling intra ocular pressure in refractory glaucoma. It is repeatable, may not be restricted to eyes with poor vision potential and a symptom-free patient is often the end result. It continues to have a role even with the advent of newer cyclodestructive procedures.

Ethical Clearance: From the Institutional Ethics Committee

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References

1. Ndulue JK, Rahmatnejad K, Sanvicente C, Wizov SS, Moster MR. Evolution of Cyclophotocoagulation. J Ophthalmic Vis Res. 2018;13(1):55-61.
2. Liu GJ, Mizukawa A, Okisaka S. Mechanism of intraocular pressure decrease after contact transscleral continuous-wave Nd:YAG laser cyclophotocoagulation. Ophthalmic Res.1994;26(2):65-79.
3. Osman EA, Al-Muammar A, Mousa A, Al-Mezaine H, Al-Obeidan SA. Controlled Cyclophotocoagulation with diode laser in refractory glaucoma and long term follow up at King Abdulaziz University Hospital, Riyadh. Saudi J Ophthalmol. 2010;24(1):9-13.
4. Frezzotti P, Mittica V, Martone G, Motolese I, Lomurno L, Peruzzi S, Motolese E. Longterm follow-up of diode laser transscleral cyclophotocoagulation in the treatment of refractory glaucoma. Acta Ophthalmol. 2010;88(1):150-5.
5. Mistlberger A, Liebmann JM, Tschiderer H, Ritch R, Ruckhofer J, Grabner G. Diode laser transscleral cyclophotocoagulation for refractory glaucoma. J Glaucoma.2001;10(4):288-93.
6. Schlote T, Derse M, Rassmann K, Nicaeus T, Dietz K, Thiel HJ. Efficacy and safety of contact transscleral diode laser cyclophotocoagulation for advanced glaucoma. J Glaucoma. 2001;10(4):294-301.
7. Schlote T, Grüb M, Kynigopoulos M. Long-term results after transscleral diode laser cyclophotocoagulation in refractory posttraumatic glaucoma and glaucoma in aphakia. Graefes Arch Clin Exp Ophthalmol. 2008;246(3):405-10.
8. Iliev ME, Gerber S. Long-term outcome of trans-scleral diode laser cyclophotocoagulation in refractory glaucoma. Br J Ophthalmol. 2007;91(12):1631-5.
9. Cheung JJC, Li KKW, Tang SWK. Retrospective review on the outcome and safety of transscleral diode laser cyclophotocoagulation in refractory glaucoma in Chinese patients. Int Ophthalmol. 2019;39(1):41-46.
10. Ghosh S, Manvikar S, Ray-Chaudhuri N, Birch M. Efficacy of transscleral diode laser cyclophotocoagulation in patients with good visual acuity. Eur J Ophthalmol. 2014;24(3):375-81.
11. Winkler NF, Funk J. Transscleral cyclophotocoagulation as primary surgical intervention in glaucoma. Klin Monbl Augenheilkd. 2013;230(4):353-7.
12. Abdull MM, Broadway DC, Evans J, Kyari F, Muazu F, Gilbert C. Safety and effectiveness of primary transscleral diode laser cyclophotoablation for glaucoma in Nigeria. Clin Exp Ophthalmol. 2018;46(9):1041-1047.
13. Ishida K. Update on results and complications of cyclophotocoagulation. Curr Opin Ophthalmol.2013;24(2):102-10.
14. Gupta V, Agarwal HC. Contact trans-scleral diode laser cyclophotocoagulation treatment for refractory glaucomas in the Indian population. Indian J Ophthalmol. 2000;48(4):295-300
15. Shakir M, Bokhari SA, Zafar S, Kamil Z, Rizvi SF. Transscleral Diode Laser Cyclophotocoagulation for Refractory Glaucoma. Pak J Ophthalmol. 2012;28(1):22-6
16. Kaushik S, Pandav SS, Jain R, Bansal S, Gupta A. Lower energy levels adequate for effective transcleral diode laser cyclophotocoagulation in Asian eyes with refractory glaucoma. Eye (Lond). 2008;22(3):398-405.

17. Bezci Aygün F, Mocan MC, Kocabeyoğlu S, İrkeç M.Efficacy of 180° Cyclodiode Transscleral Photocoagulation for Refractory Glaucoma. Turk J Ophthalmol. 2018;48(6):299-303.

18. Quigley HA. Improved Outcomes for Transscleral Cyclophotocoagulation Through Optimized Treatment Parameters. J Glaucoma. 2018;27(8):674-681.

19. Chen MF, Kim CH, Coleman AL. Cyclodestructive procedures for refractory glaucoma. Cochrane Database Syst Rev. 2019 Mar 10;3:CD012223. doi: 10.1002/14651858.CD012223.pub2.[Epub ahead of print]

20. Shah P, Bhakta A, Vanner EA, Kishor KS, Greenfield DS, Maharaj ASR. Safety and Efficacy of Diode Laser Transscleral Cyclophotocoagulation in Eyes With Good Visual Acuity. J Glaucoma. 2018;27(10):874-879

21. Bleisch D, Furrer S, Funk J.Rates of glaucomatous visual field change before and after transscleral cyclophotocoagulation: a retrospective case series. BMC Ophthalmol. 2015;15:179.

22. Hasan S, Theilig T, Unterlauft JD. Comparing the efficacy of trabeculectomy and diode laser cyclophotocoagulation in primary open-angle glaucoma. Int Ophthalmol. 2019 Mar 4. doi: 10.1007/s10792-019-01093-w.[Epub ahead of print]

23. Stanca HT1, Munteanu M, Jianu DC, Motoc AGM, Tăbăcaru B, Stanca S, Ungureanu E, Boruga VM, Preda MA. New perspectives in the use of laser diode transscleral cyclophotocoagulation. A prospective single center observational cohort study. Rom J Morphol Embryol. 2018;59(3):869-872.

24. Choy BNK, Lai JSM, Yeung JCC, Chan JCH. Randomized comparative trial of diode laser transscleral cyclophotocoagulation versus Ahmed glaucoma valve for neovascular glaucoma in Chinese-a pilot study. Clin Ophthalmol. 2018;12:2545-2552.

25. Graber M, Rothschild PR, Khoueir Z, Bluwol E, Benhatchi N, Lachkar Y. High intensity focused ultrasound cyclodestruction versus cyclodiode treatment of refractory glaucoma: A retrospective comparative study. J Fr Ophtalmol. 2018 Sep;41(7):611-618.

26. Kuchar S, Moster MR, Reamer CB,Waisbourd M. Treatment outcomes of micropulse transscleral cyclophotocoagulation in advanced glaucoma. Lasers Med Sci.2016;31(2):393-6.

27. Marra KV, Wagley S, Omar A, Kinoshita T, Kovacs KD, Silva P, Kuperwaser MC, Arroyo JG. Case-matched comparison of vitrectomy, peripheral retinal endolaser, and endocyclophotocoagulation versus standard care in neovascular glaucoma. Retina. 2015;35(6):1072-83.

28. Morales J, Al Qahtani M, Khandekar R, Al Shahwan S, Al Odhayb S, Al Mobarak F, Edward DP. Intraocular Pressure Following Phacoemulsification and Endoscopic Cyclophotocoagulation for Advanced Glaucoma: 1-Year Outcomes. J Glaucoma. 2015;24(6):e157-62.

29. Yang Y, Zhong J, Dun Z, Liu XA, Yu M. Comparison of Efficacy Between Endoscopic Cyclophotocoagulation and Alternative Surgeries in Refractory Glaucoma: A Meta-analysis. Medicine (Baltimore). 2015;94(39):e1651.

30. Kraus CL, Tychsen L, Lueder GT, Culican SM. Comparison of the effectiveness and safety of transscleral cyclophotocoagulation and endoscopic cyclophotocoagulation in pediatric glaucoma. J Pediatr Ophthalmol Strabismus. 2014;51(2):120-7.

31. Zaarour K, Abdelmassih Y, Arej N, Cherfan G, Tomey KF, Khoueir Z. Outcomes of Micropulse Transscleral Cyclophotocoagulation in Uncontrolled Glaucoma Patients. J Glaucoma. 2019;28(3):270-275.

32. Subramaniam K, Price MO, Feng MT, Price FW Jr. Micropulse Transscleral Cyclophotocoagulation in Keratoplasty Eyes. Cornea. 2019 Feb 6. doi: 10.1097/ICO.0000000000001897.[Epub ahead of print]

33. Abdelrahman AM, El Sayed YM. Micropulse versus Continuous Wave Transscleral Cyclophotocoagulation in Refractory Pediatric Glaucoma. J Glaucoma. 2018;27(10):900-905.

34. Yu SW, Ma A, Wong JK. Micropulse Laser for the Treatment of Glaucoma: A Literature Review. Surv Ophthalmol. 2019 Jan 10. pii: S0039-6257(18)30060-2. doi: 10.1016/j.survophthal.2019.01.001. [Epub ahead of print]

35. Tham CC, Lai JS, Fung PC, Chua JK, Poon AS, Lam DS. Physical effects of reuse and repeated ethylene oxide sterilization on transscleral cyclophotocoagulation laser G-probes. J Glaucoma.

2002;11(1):21-5.

36. Carrillo MM, Trope GE, Chipman ML, Buys YM. Repeated use of transscleral cyclophotocoagulation laser G-probes. J Glaucoma. 2004;13(1):51-4.

37. Rootman DB, Howarth D, Kerr JQ, Flanagan JG, Trope GE, Buys YM. Sterile single use cover for the G-probe Transscleral Cyclodiode. J Glaucoma. 2011;20(4):260-5.