



Original Research Article

To evaluate effect of intraocular pressure control on central corneal thickness, horizontal corneal diameter and axial length in primary congenital glaucoma

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ABSTRACT

Aim: To evaluate the effect of intraocular pressure (IOP) on central corneal thickness (CCT), horizontal corneal diameter (HCD), axial length (AL) in patients with primary congenital glaucoma (PCG) after antiglaucoma surgery.

Materials and Methods: In this hospital based interventional study 36 patients (66 eyes) of PCG who underwent antiglaucoma surgery were included in the study. For each patient visual acuity, anterior and posterior segment examination, IOP, AL, CCT, HCD and refraction (in clear media) were recorded pre and post operatively (3 weeks, 3 months, 6 months). B scan ultrasonography was done to measure AL and to rule out posterior segment pathology. Surgery was performed by a glaucoma expert (by a single surgeon).

Results: Bilateral involvement was present in 83.33% with the most common symptom being photophobia and watering (30.56% each). The mean IOP, CCT, HCD, VCD and AL before surgery were 26.88±2.78 mmHg, 614.38±89.41 μ , 14.41±1.26mm, 13.19±1.46mm and 24.78±2.21mm and at 6 months were 13.85±1.93 mmHg, 548.56±63.13 μ , 14.62±0.49 mm, 13.34±1.10 mm and 25.73±1.36mm respectively. 59.1% of the patients had corneal clearing at 6 months.

Conclusion: Control of IOP affects various parameters of eye like CCT, HCD and AL. Early surgery is the definitive line of management for controlling IOP in PCG patients.

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1. Introduction

Glaucoma is a chronic progressive optic neuropathy caused by a group of ocular conditions which led to damage of the optic nerve with loss of visual functions.¹ The most common risk factor known is raised Intra Ocular pressure (IOP). Control of IOP can halt the progression of the disease. Congenital or developmental glaucoma refers to glaucoma associated with developmental anomalies of eye present at birth. It may be primary resulting from maldevelopment of aqueous outflow system for eg. structural maldevelopment of iridocorneal angle (goniodysgenesis), trabecular meshwork (trabeculodysgenesis), iris (iridodysgenesis) or cornea

(corneodysgenesis) or secondary resulting from damage to the aqueous outflow system due to maldevelopment of some other portion of eye for eg. angle closure due to pupillary block in a small eye, microspherophakia or dislocated lens, or as a forward shift of iris-lens diaphragm in persistent primary hyperplastic vitreous or retinopathy of prematurity.²

Primary congenital glaucoma (PCG) accounts for 0.01-0.04% of total blindness and classified depending on age or as primary and secondary depending on syndromic association.³ The childhood glaucoma research network (CGRN) has provided a new classification system. It comprises of PCG, Juvenile Open Angle Glaucoma and Glaucoma associated with Non Acquired Ocular Anomalies.⁴ The gene responsible for PCG are CYP1B1 or LTBP2 and they are inherited in an autosomal

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recessive manner. The classic triad consists of lacrimation, photophobia and blepharospasm. PCG is diagnosed when glaucoma is present in a child with isolated angle anomaly without any other ocular or systemic pathology.⁵

PCG should be treated aggressively as children have long life span and it has deep impact on psychological and socio-economical growth to the family. Surgery is the definitive line of management for PCG. Antiglaucoma medication continued till child awaits surgery. For many years, goniotomy remained the classic choice for primary congenital glaucoma till a new technique called 'trabeculectomy ab externo' was described. Control of IOP has an impact on axial length (AL), central corneal thickness (CCT) and horizontal corneal diameter (HCD). Some investigators compared AL growth and IOP in PCG. Others analyzed the correlation of postoperative IOP reduction with postoperative AL growth and reported good correlation.⁶ So we studied the effect of IOP on CCT, HCD and AL in patients with PCG after antiglaucoma surgery.

2. Materials and methods

Ours was a prospective interventional study conducted at a tertiary eye care centre in western India from January 2016 to December 2016. 66 eyes of 36 patients diagnosed with PCG, undergone anti glaucoma surgery and given informed consent were included. Patients diagnosed with secondary glaucoma, other congenital anomalies, irido-corneal endothelial syndrome, subluxation of lens, posterior segment problems and patients whose parents were not willing to participate in the study were excluded from the study. The study was conducted as per Ethical guidelines outlined in the Declaration of Helsinki. Informed written consent in vernacular language was taken from parents.

Data was collected to study the effect of IOP control on CCT, HCD and AL in patients with PCG. For each patient, birth history, family history, laterality, age of onset, sex, anterior and posterior segment examination, type of surgery, IOP (by Goldman Applanation Tonometer - Perkin's tonometer), AL (B scan ultrasonography), CCT (Ultrasonic Pachymeter), HCD (using Castroveijo caliper), corneal clarity and disc evaluation for glaucomatous damage (if media permitted) were recorded by a single surgeon A and surgery was performed by surgeon B. Patients below two years underwent combined trabeculotomy with trabeculectomy (conventional). Patients above two years underwent trabeculectomy with Mitomycin C (MMC, 0.2mg/ml). Patients were examined on first and 7th post operative day. Examination Under Anesthesia (EUA) was performed at 3 weeks, 3 months and 6 months post surgery for IOP, CCT, HCD and AL measurements. Sevoflurane was used as the anesthetic agent as it does not have much effect on intraocular pressure. If uncontrolled, single topical antiglaucoma (Timolol maleate-0.5%) medication was started. Surgical success was defined as a post operative

IOP less than or equal to 21 mm of Hg with or without medication with no requirement for additional glaucoma surgery and no evidence of progression of optic nerve head cupping on B scan USG or enlargement of Cup disc ratio.

3. Results

Thirty six patients (66 eyes) enrolled in the study, 55.56% were males and 44.44% were females. Age wise distribution of the patient showed that 61.11% patients were < 1year, 33.33% patients were >1 year - <5years, and 5.56% patients were >5years of age. Eye involvement was bilateral in 83.33% patients, while it was unilateral in remaining 16.67% patients. Of the patients with unilateral eye involvement 11.11% patients had right eye involvement whereas 5.56% patients have left eye involvement. Complain analysis of the patients suggested that 30.56% parents complained of larger eyeballs, 30.56% parents complained of not able to open eyes in light (photophobia) with watering, 22.22% patients complained of white eye ball, 16.67% patients had diminution of vision. Haab's striae was present in 54.55% patients. 61.11% patients underwent combined trabeculotomy and trabeculectomy with Mitomycin C (MMC) and 38.89% underwent trabeculectomy with MMC (Figure 1). Reduction in IOP and CCT post operatively was statistically significant at 3 weeks and 6 months follow up ($p < 0.05$). (Table 1) Corneal edema was present in all the eyes preoperatively 100%. 33.33% of these eyes had corneal clearing at 3 weeks, while 59.1% eyes had corneal clearing at 6 months. Change in AL and HCD was also found to be statistically significant ($p < 0.05$). (Table 1) Postoperatively 19.70% of eyes were prescribed single IOP lowering medication at 3 weeks, however, none of the patients required IOP lowering medication at 6 months.

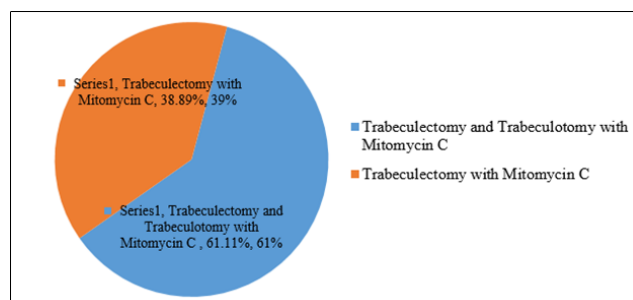


Fig. 1: Type of surgical treatment

4. Discussion

The mean IOP of the patients pre operatively was 26.88 ± 2.78 mmHg, the same was 19.50 ± 2.19 mmHg at 3 weeks post-op. follow up and 13.85 ± 1.93 mmHg at 6 months follow up. Reduction in IOP was found to be statistically significant ($p < 0.05$). This finding was comparable with

Table 1: Mean IOP, CCT, HCD and AL pre and post operative

Variable	Pre operative	3 weeks post-op.	6 months post-op.
Mean IOP(mmHg)	26.88 ± 2.78	19.50 ± 2.19	13.85 ± 1.93
Mean CCT(μ)	614.38 ± 89.41	578.38 ± 72.05	548.56 ± 63.12
Mean HCD (mm)	14.41 ± 1.26	14.52 ± 0.91	14.62 ± 0.49
Mean AL (mm)	24.78 ± 2.21	24.97 ± 1.69	25.73 ± 1.36

IOP- Intraocular pressure; CCT- Central corneal thickness; HCD- Horizontal corneal diameter; AL – Axial length

findings of various other studies. Alsheikheh A et al⁷ in their study found that the mean IOP before surgery was 31.0 +/- 7.9 mmHg (17.5-52.0) and 15.0 +/- 3.9 mmHg (7.0-28.0) at the last visit (mean follow up -32 months). In another study by Kiefer G et al, the mean pretreatment IOP before surgery was 28.4 +/- 6.9 mmHg and mean IOP at the end of follow-up was 17.5 +/- 5.8 mmHg even at longer follow up of around 28 months.⁸

The mean CCT of the patients pre operatively was 614.38 ± 89.41 μ while it was 578.38 ± 72.05 μ and 548.56 ± 63.12 μ at 3 and 6 months post-op. follow up and reduction in CCT was statistically significant (p<0.05%). The decrease in the mean CCT may be due to the clearing of the corneal edema with control of IOP post operatively. The mean CCT at 3 weeks in our study, 578.38 ± 72.05 μ , was significantly less than that in the study by Amini H et al.,⁹ 589.42 ± 53.44 μ . The mean CCT at 6 months was 548.56 ± 63.12 μ while in the study by Oberacher-Velten and colleagues¹⁰ it was 569.4 ± 16 μ . The mean CCT at 6 months in our study was comparable to age matched normal controls in whom the CCT was 556.14 ± 30.51 μ . It is clear that with decrease in IOP the Corneal edema decreases and thus decreases the CCT, which establishes a positive correlation between IOP control and CCT.

In our study, the mean HCD increased post operatively. The change in the mean HCD was clinically significant (P<0.05). The mean HCD which was 14.41 ± 1.26 mm preoperatively became 14.52 ± 0.91 mm at 3 weeks follow up and 14.62 ± 0.49 mm at 6 months follow up. This signifies that with IOP control, corneal stretching decreases and the rate at which mean HCD increases in PCG becomes slow. However the mean HCD was still more than the mean HCD of age controlled group. Difference in HCD in our study was comparable to the study conducted by Cronemberger S et al.,¹¹ both pre and post operatively, 13.45 ± 1.00 mm and 13.98 ± 1.01 mm, respectively. This was due to the normal growth of the eyeball (unlike adults) with increasing age and also due to abnormal growth due to increase in IOP. This difference may be due to the study population selected in both the studies, initial higher parameters and late presentation in our patients.¹²

The mean AL of the patients pre operatively was 24.78 ± 2.21 mm while that after surgery was 24.97 ± 1.69 mm at 3 weeks follow up and 25.73 ± 1.36 mm at 6 months follow up and was statistically significant (p<0.05%). In another study the AL was preoperatively and post operatively 24.57

± 2.71 mm and 25.37 ± 2.66 mm suggesting marginally increase which is due to continued normal growth of eyeball during childhood.* There are various studies that positively correlated the decrease in IOP postoperatively and axial length. In the study by Kiefer G et al., axial length growth was normalized at the end of follow-up.* In the study by Alsheikheh A the mean axial length of the eyeball was 22.6 +/- 1.8 mm at first examination and it was 24.4 +/- 2.0 mm at the last visit suggesting increase AL.

With decrease in IOP post surgically the corneal edema decreased. 59.1% eyes had corneal clearing at 6 months. Only 19.67% (n=13) eyes required IOP reducing medication postoperatively at 3 weeks. Topical Timolol Maleate (0.5%), a beta blocker, was agent of choice in all the patients who required IOP reducing medication. However, none of the patients required IOP reducing medication at 6 months postoperatively follow up since the IOPs were well controlled in all the patients. Timolol is first line of drug for PCG as it reduces IOP by 20% and it is economic and since majority of the patients coming to our set up were financially poor.

Therefore, in our study of patients with PCG, IOP was controlled (<21mmHg) with Trabeculotomy +/- Trabeculectomy with MMC. Also it was seen that control of IOP had positive correlation with CCT, HCD and AL.

5. Limitations

As our study included only 66 eyes of 36 patients, study involving more number of patients is recommended. Study duration was one year and IOP <21mmHg was the criteria for surgical success. Most of our patients came with hazy media so refraction and fundus evaluation was not possible. Genetic correlation and amblyopia development were not studied.

6. Conclusion

Surgical management is the definite line of treatment for controlling IOP (only modifiable risk factor) of PCG patients. Management should be done as early as possible to achieve VISION 2020 target to prevent childhood blindness, and they should be followed up lifelong regularly for corneal diameter, IOP, AL, refraction and fundus examination as and when required as they might need antiglaucoma medication or second Surgery in the future. With control of IOP, CCT and corneal edema decreases. Increase in AL and HCD may

be because of normal growth of eyeball in childhood.

7. Source of Funding

None.

8. Conflict of Interest

The authors declare that there is no conflict of interest.

References

1. Maurya R. Glaucoma burden: Indian scenario. *Ind J Clin Exp Ophthalmol.* 2017;3(4):387–8.
2. Sihota, Tandon R. Parsons' diseases of the eye. 21st ed. Elsevier Health Sciences; 2011.
3. Francois J. Congenital glaucoma and its inheritance. *Ophthalmologica.* 1972;181:61–73.
4. Thau A, Lloyd M, Freedman S, Beck A, Grajewski A, Levin AV. New classification system for pediatric glaucoma. *Curr Opin Ophthalmol.* 2018;29(5):385–94. doi:10.1097/ico.0000000000000516.
5. Mandal AK. Current concepts in the diagnosis and management of developmental glaucomas. *Indian J Ophthalmol.* 1993;41:51–70.
6. Zhang X, Du S, Fan Q, Peng S, Yu M, Ge J. Long-term surgical outcomes of primary congenital glaucoma in China. *Clinics.* 2009;64(6):543–51. doi:10.1590/s1807-59322009000600009.
7. Alsheikheh A, Klink J, Klink T, Steffen H, Grehn F. Long-term results of surgery in childhood glaucoma. *Graefes Arch Clin Exp Ophthalmol.* 2007;245(2):195–203. doi:10.1007/s00417-006-0415-2.
8. Kiefer G, Schwenn O, Grehn F. Correlation of postoperative axial length growth and intraocular pressure in congenital glaucoma – a retrospective study in trabeculectomy and goniotomy. *Graefes Arch Clin Exp Ophthalmol.* 2001;239(12):893–9. doi:10.1007/s00417-001-0377-3.
9. Daneshvar R, Fakhraie G, Abolmaali S, Amini H, Amini N. Central corneal thickness in Iranian congenital glaucoma patients. *Middle East Afr J Ophthalmol.* 2012;19(2):194–8. doi:10.4103/0974-9233.95248.
10. Oberacher-Velten I, Prasser C, Lorenz B. Evolution of central corneal thickness in children with congenital glaucoma requiring glaucoma surgery. *Graefes Arch Clin Exp Ophthalmol.* 2008;246:397–403. doi:10.1007/s00417-007-0690-6.
11. Cronemberger S, Calixto N, Milhomens TGA, Gama PO, Milhomens EG, Rolim H, et al. Effect of intraocular pressure control on central corneal thickness, horizontal corneal diameter, and axial length in primary congenital glaucoma. *J Am Assoc Pediatr Ophthalmol Strabismus.* 2014;18(5):433–6. doi:10.1016/j.jaapos.2014.05.012.
12. Senthil S, Badakere S, Ganesh J, Krishnamurthy R, Dikshit S, Choudhari N, et al. Profile of childhood glaucoma at a tertiary center in South India. *Indian J Ophthalmol.* 2019;67(3):358–65. doi:10.4103/ijo.ijo_786_18.

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