ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 10 | October - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE STUDY OF CYCLOPLEGIC REFRACTION BY CYCLOPENTOLATE AND ATROPINE EYE DROPS IN CHILDREN WITH HYPEROPIA BETWEEN 5 TO 12 YEARS OF AGE

Ophthalmology

Dr. Poonam Sonagra M.S., Ophthalmology, Western railway hospital, Sabarmati, Ahmedabad, Gujarat, India.

Dr. Jigna Patel* M.S., Ophthalmology, M & J institute of Ophthalmology, Civil hospital, Asarva, Ahmedabad, Gujarat, India. *Corresponding Author

ABSTRACT

Background: Refractive error is one of the most common causes of visual impairment among children globally. Cycloplegic refraction is a pivotal component of pediatric eye examination. Because of presence of powerful accommodation in hyperopic children, cycloplegic refraction by using an appropriate cycloplegic drug is mandatory. Therefore here we have compared cycloplegic refraction by using cyclopentolate (1%) and atropine (1%) eye drops in children with hyperopia between 5-12 years of age group. We aim to compare the cycloplegic effect of cyclopentolate (1%) and atropine (1%) eye drops in hyperopic children between 5-12 years of age.

Methods: We conducted a prospective cohort study of total 100 children ages 5-12 years with hyperopia. The cohort was divided into two randomized age groups: Group-A (5-8 years of age) and Group-B (9-12 years of age). Cycloplegic refraction was performed using cyclopentolate (1%) and atropine (1%) eye drops in each child. We compared retinoscopic findings in terms of spherical equivalent (SE) between Group-A and Group-B using unpaired t-test and analysis was performed using graphpad software.

Results: A total of 100 children completed the study, of which 43 were in Group-A and 57 in Group-B. In the Group-A, mean retinoscopic (SE) scores were 3.50 ± 1.06 and 4.01 ± 1.13 after using cyclopentolate and atropine eye drops respectively and difference was statistically significant (P=0.004). While in case of Group-B, mean retinoscopic (SE) scores were 2.96 ± 0.72 and 3.06 ± 0.79 respectively, which were not found to be statistically significant (P=0.075).

Conclusions: The comparison of cyclopentolate (1%) and atropine (1%) eye drops in hyperopic children, the difference in group-A (5-8 years of age) was statistically significant, so in this group, atropine (1%) eye drops should be used for accurate cycloplegic refraction. But the difference in group B (9-12 years of age) was not statistically significant, so in this age group cyclopentolate (1%) can give good result of cycloplegia with lesser side effects and shorter duration of action which is preferable and convenient.

KEYWORDS

Cycloplegic refraction, Retinoscopy, Hyperopia, Cyclopentolate, Atropine.

INTRODUCTION

Cycloplegic refraction is an important procedure in pediatric ophthalmic examination. The powerful accommodative abilities of children and their inability to reliably respond to subjective refraction require objective technique like retinoscopy.[1] The refracting power of the eye results from the static and the accommodative power of the eye. Accommodative power is the variable force of accommodation that alters the path of light rays by causing the ciliary body to cause changing the curvature of the lens. [2] Younger the patient, larger the patient's amplitude of accommodation and it is more difficult to hold it back. Because of this powerful accommodation, especially in hyperopic children, cycloplegic refraction by using an appropriate cycloplegic drug is mandatory.[2]

Hyperopia is a type of refractive error in which parallel rays of lights are focused behind, instead of on, the retina with accommodation being at rest. There are following component of hyperopia related to accommodation: [19]

- Total hyperopia – total amount of refractive error which is estimated after complete cycloplegia with atropine. It consists of latent and manifest hyperopia.
- Latent hyperopia implies amount of hyperopia which is normally corrected by the inherent tone of ciliary muscle, which is high in children and gradually decreases with age. It can be detected by cycloplegic refraction.
- Manifest hyperopia is the remaining portion of total hyperopia which is not corrected by cilliary tone. It may be either facultative or absolute.

Facultative hyperopia is that which can be overcome by patient's accommodative effort and absolute hyperopia is the residual part of manifest hyperopia which cannot be compensated by patient's accommodative effort.

Thus, total hyperopia= latent + manifest (facultative + absolute) hyperopia.

Children with hyperopia generally have sufficient accommodative reserve to see clearly, but many times they develop asthenopic symptoms like blurred vision, eyeache, headache after sustained reading or changing focus from near to far, who use their accommodation to compensate for their hyperopic refractive error and therefore require cycloplegic examination when the manifest refraction reveals too little hyperopia to account for their symptoms. Children with low hyperopia may present as myopic during non cycloplegic refraction; this so-called pseudomyopia can be identified by cycloplegic evaluation.[2]

Cycloplegia is the paralysis of the ciliary muscle of the eye resulting in dilatation of pupil and paralysis of accommodation. This can be achieved by cycloplegic drugs like atropine and cyclopentolate which are anticholinergic in property so they block the muscarinic action of acetylcholine. This action inhibits cholinergic stimulation of the iris sphincter and ciliary muscle of an eye, which results in mydriasis and cycloplegia. For cycloplegic refraction, we had used a streak retinoscope to illuminate the inside of the eye and to observe the light that is reflected from the retina. These reflected rays change as they pass out through the optical components of the eye and by examining just how these emerging rays change; we measured the refractive power of the eye in each child.[16]

In this article, we compared cycloplegic refraction by using cyclopentolate (1%) and atropine (1%) eye drops in children with hyperopia between 5-12 years of age for evaluation of efficacy and safety of these two commonly used cycloplegic drugs.

MATERIAL AND METHODS

Study Design: Randomized, comparative, prospective cohort study.
Study Duration: 1 year
Total 100 children (200 eyes) with hyperopia were participated for this study based on the following inclusion and exclusion criteria.

Inclusion Criteria:

1. Patient's parents willing to take part in the study and gave written and informed consent.
2. Patients between 5 to 12 years of age with hyperopia.

Exclusion Criteria:

1. The patients with history of allergy to eye drops used in the study.
2. Patients with a manifest squint, amblyopia or suppression.
3. Patients with any organic eye diseases.
4. The Patients (or parents) were not ready to give consent for enrolment into the study.

5. Uncooperative and mentally retarded patients.

Study Procedure:

Cycloplegic refraction was performed by using both Cyclopentolate (1%) and Atropine (1%) eye drops. We compared the cycloplegic refraction of both the drugs in two age randomized groups, 5-8 years of age group (Group-A) and 9-12 years of age group (Group-B).

Regimen 1 was consisted of instillation of cyclopentolate (1%) eye drops; 1 drop instilled in the conjunctival sac thrice in each eye at 10 minutes interval and retinoscopy was done after 45 minutes of instilling the first drop. Patients were called for post cycloplegic refraction after 5 days.

Regimen 2 was consisted of instillation of atropine (1%) eye drops, 1 drop instilled in each eye twice a day for 3 days at patient's home. After the instillation of drops, the lacrimal puncta are occluded by pressure giving on the medial canthus for 1-2 minutes to minimize its systemic absorption. Parents were informed about the signs of local and systemic toxicity of the drugs and they are instructed to inform if any adverse effect is noted. After 3 days, retinoscopy was performed and patients were called for post cycloplegic refraction after 15 days.

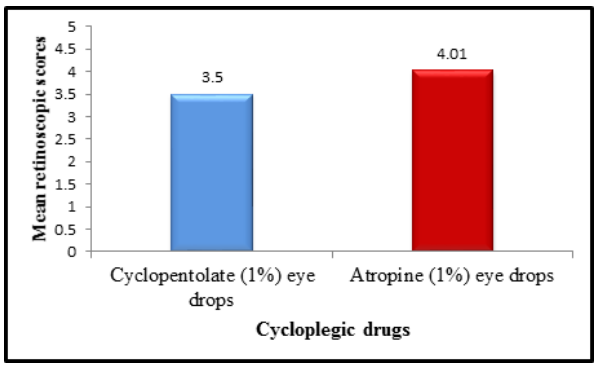
Statistical Analysis:

The data was entered and tabulated in Microsoft Excel 2007. Mean retinoscopic findings in terms of spherical equivalent (SE) were compared between these two groups. Statistical analysis was done by using graphpad software, unpaired t-test and P-value < 0.05 was considered statistically significant.

RESULTS

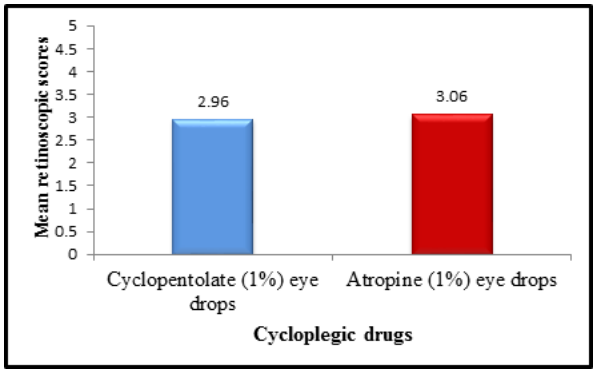
This study had been conducted on 100 children of 5-12 years of age group with hyperopia, out of which 49 were male and 51 were female. They were randomly divided into two groups: group-A (5-8 years of age) and group-B (9-12 years of age) comprised 43 and 57 children respectively.

In group-A, mean retinoscopic scores were 3.50 ± 1.06 and 4.01 ± 1.13 by using cyclopentolate (1%) and atropine (1%) eye drops respectively (Graph 1). This difference was statistically significant (P=0.004).



Graph 1: Mean Retinoscopic Scores In Group-A

In group-B, mean retinoscopic scores were 2.96 ± 0.72 and 3.06 ± 0.79 by using cyclopentolate (1%) and atropine (1%) eye drops respectively (Graph 2). The difference in this age group was not statistically significant (P=0.075) (Table 1).



Graph 2: Mean Retinoscopic Scores In Group-B

Table 1: Retinoscopic Scores In Two Age Groups With Mean And Standard Deviation

Group	Mean retinoscopic(SE) scores ± SD	
	Cyclopentolate (1%) eye drops	Atropine (1%) eye drops
A	3.50 ± 1.06	4.01 ± 1.13
B	2.96 ± 0.72	3.06 ± 0.79

DISCUSSION

Refractive error has been considered one of the priorities of the global initiative for the elimination of avoidable blindness as it is second largest cause of treatable blindness and one of the leading causes of visual impairment. Children constitute particularly vulnerable group, in whom uncorrected refractive error may have a dramatic impact on learning capability and educational potential. [35, 36] Cycloplegic refraction has remained a reliable and valid procedure for visual assessment particularly among young patients. In children, because of powerful accommodation especially in presence of hyperopia, cycloplegic refraction rather than subjective refraction is mandatory.[3] An ideal cycloplegic would have no ocular and systemic side effects, it provides a rapid onset of cycloplegia and inhibit accommodation completely for sufficient period and then swiftly restore effective accommodation.[3] There is no single cycloplegic drug that covers all these requirements, but some drugs do satisfactorily achieve the desired clinical result with minimum side effects.[3]

Full cycloplegia is a primary procedure in the diagnosis and treatment of distinct critical ocular disorders, mainly in children who are at the critical age of visual maturation and having greater amplitudes of accommodation which is an obstacle against actual refraction. Cycloplegia holds back the accommodative power of the eye by temporarily paralyzing the ciliary muscle, allowing the objective refraction of the eye to be measured.[4]

Atropine is the gold standard for producing cycloplegia; however, due to its side effects and longer duration of action, has gradually been replaced by cyclopentolate, which has fewer side effects, rapid onset and shorter duration of action with effective cycloplegia.[5,6] Moreover, lengthened cycloplegia with atropine during a sensitive period of visual maturation, in some children, might potentiate stimulus deprivation amblyopia.[7]

Rosenbaum et al. assessment of hyperopia in children with esotropia, the accuracy of atropine was 0.34D more effective then compared with cyclopentolate, this value is clinically insignificant.[8]

Zetterstrom C et al. The cycloplegic effect of a single dose of cyclopentolate 0.85% and phenylephrine 1.5% compared with atropine eye drops two times a day for 3 days in patients between 3-6 years of age and found that the difference was insignificant.[9]

Salvesen and Kohler suggested that there was a 0.23D difference between cyclopentolate and atropine cycloplegia by automated refractors that is insignificant.[10]

It is known that atropine commonly used cycloplegic drug in the assessment of hyperopic refraction in children. Slow onset, longer duration of cycloplegia, adverse reactions and uncertain compliance are some disadvantages of this drug. [11,12,13] Cyclopentolate has a rapid onset and shorter duration of action with fewer side effects as compare to atropine. The maximum cycloplegic effect is attained at around 45-60 minutes and remains stable for about 90 minutes.[14]

Our study showed that mean retinoscopic scores by using cyclopentolate (1%) and atropine (1%) eye drops in children between 5 to 8 years of age group show a statistically significant difference. So in this age group, cycloplegic refraction should be done by using atropine (1%) eye drops for accurate refraction. But in children between 9 to 12 years of age group, it does not show any statistically significant difference. Thus, cyclopentolate (1%) eye drops can be used for cycloplegic refraction in children between 9-12 years of age which is safe and equally effective.

CONCLUSIONS

Cycloplegic refraction is an objective procedure which allows estimation of actual refractive status of an eye by abolishing the accommodation. In our study, we compare the cycloplegic effect of cyclopentolate and atropine eye drops in children with hyperopia where result of group-A (5-8 years of age) was statistically significant.

Therefore, in this age group, cycloplegic refraction should be done by using atropine (1%) eye drops for better visual assessment. But in group B (9-12 years of age) it was not statistically significant, so in this age group, cyclopentolate (1%) eye drops can be used with lesser side effects, better compliance and equal efficacy.

REFERENCES

1. Craig A, McKeown, Stefanie L, Davidson. Albert Jacobiec's Principles & Practice in Ophthalmology 3rd edition 2008; The Pediatric Eye Examination 298: 4141
2. Mindel JS. Cholinergic pharmacology. Duane's Foundations of Clinical Ophthalmology 1994; Vol. 3: 37.
3. Amos JF. Clinical Ocular Pharmacology, 4th edition 2001; Oxford: 425–429.
4. Farhood QK, et al. Cycloplegic Refraction in Children with Cyclopentolate versus Atropine 2012; 3: 239.
5. Refractive accommodative esotropia by means of retinoscopy, autorefractometry, and biometric lens thickness. Acta Ophthalmol 1999; 77: 426-429.
6. Fraunfelder FT: Drug-Induced Ocular Side Effects and Drug Interactions, 2nd edition, 1982; 373-374.
7. Hoefnagel D. Toxic effects of atropine and homatropine eye drops in children, New Engl J Med 1961; 264: 168–171.
8. Rosenbaum AL, Bateman JB, Bremer DL, et al: Cycloplegic refraction in esotropic children, Cyclopentolate versus atropine 1981; 88: 1031–34.
9. Zetterstrom C. A cross-over study of the cycloplegic effects of a single topical application of cyclopentolate - phenylephrine a routine atropinization for 3.5 days. Acta Ophthalmol 1985; 63: 525–529.
10. Salvesen S, Kohler M, et al. Automated refraction, A comparative study of automated refraction with the Nidek AR-1000 autorefractor and retinoscopy, Acta Ophthalmol 1991; 69: 342–346.
11. Khurana AK, Ahluwalia BK, Rajan C. Status of cyclopentolate as a cycloplegic in children: A comparison with atropine and homatropine, Acta Ophthalmol 1988; 66: 721–724.
12. Goldstein JH, Schneekloth BB, et al. Atropine versus cyclopentolate plus tropicamide in esodeviations, Ophthalmic Surg Lasers 1996; 27: 1030–1034.
13. Yen MY, Liu JH, Kao SC, et al. Comparison of the effect of atropine and cyclopentolate on myopia, Ann Ophthalmol 1989; 21: 180–182.
14. Lin LLK, Shih YF, Hsiao CH, et al: The cycloplegic effects of cyclopentolate and tropicamide on myopic children, J Ocul Pharmacol Ther 1998; 14: 331–335.
15. A. K. Khurana: Comprehensive Ophthalmology, 4th edition, 2007; 3: 32, 555.
16. American Academy of Ophthalmology, The Eye M.D Association, Clinical Optics, Optics Of The Human Eye 2011-2012; 3(3): 113-115.
17. Benjamin WJ, Borish IM: Borish's clinical refraction, 2nd edition 2006; 9-11.
18. Augsburger AR, Amos JF: Diagnosis and management in vision care 1987; 101-19.
19. Rosenberg R, Eskridge J.B., Amos J.F. et al: Clinical procedures in optometry, Automated refraction 1999; 168–73.
20. Jonathan d. Wirtschafter, Gary s. Schwartz: Retinoscopy; 1: 37.
21. Farhood QK: J Clin Exp Ophthalmology, Cycloplegic Refraction in Children with Cyclopentolate versus Atropine 2012; 3:239.
22. Lian-Hong Pi1, Jia-Liang Zhao, Qin Liu1 et al: Comparison of cycloplegic retinoscopy using cyclopentolate or tropicamide eye drops in an epidemiologic study of pediatric refraction among school-aged children, Scientific Research and Essays 2011; 6(3): 635-640.
23. Wang XM, Ma LX, Wang LH: Research of cyclopentolate 1% on the effect of cycloplegia for Chinese hyperopic children 2011; 47(11):989-94.
24. T Rotsos, D Grigoriou, A Kokkolaki et al: A comparison of manifest refractions, cycloplegic refractions and retinoscopy on the RMA-3000 autorefractometer in children aged 3 to 15 years, Clinical Ophthalmology 2009; 3: 429–431.
25. Amos JF: Clinical Ocular Pharmacology, 4th edition 2001; Oxford: 425–429.
26. Celebi S, Aykan U: Comparison of cyclopentolate and atropine in patients with refractive accommodative esotropia by means of retinoscopy, autorefractometry and biometric lens thickness. Acta Ophthalmol 1999; 77: 426-429.
27. Fraunfelder FT: Drug-Induced Ocular Side Effects and Drug Interactions, 2nd edition, 1982; 373-374.
28. Hoefnagel D: Toxic effects of atropine and homatropine eye drops in children, New Engl J Med; 264: 168–171.
29. Zetterstrom C: A cross-over study of the cycloplegic effects of a single topical application of cyclopentolate-phenilephrine a routine atropinisation for 3.5 days. Acta Ophthalmol 1985; 63: 525–529.
30. Salvesen S & Kohler M: Automated refraction, A comparative study of automated refraction with the Nidek AR-1000 autorefractor and retinoscopy, Acta Ophthalmol 1991; 69: 342–346.
31. Khurana AK, Ahluwalia BK & Rajan C: Status of cyclopentolate as a cycloplegic in children: A comparison with atropine and homatropine, Acta Ophthalmol 1988; 66: 721–724.
32. Goldstein JH & Schneekloth BB: Atropine versus cyclopentolate plus tropicamide in esodeviations, Ophthalmic Surg Lasers 1996; 27: 1030–1034.
33. Yen MY, Liu JH, Kao SC et al: Comparison of the effect of atropine and cyclopentolate on myopia, Ann Ophthalmol 1989; 21: 180–182.
34. Lin LLK, Shih YF, Hsiao CH et al: The cycloplegic effects of cyclopentolate and tropicamide on myopic children, J Ocul Pharmacol Ther 1998; 14: 331–335.
35. Thylefors B. A global initiative for the elimination of avoidable blindness [editorial]. American Journal of Ophthalmology, 1998, 25: 90–93, 15.
36. Pararajasegaram R. VISION 2020 — The Right to Sight: from strategies to action. American Journal of Ophthalmology, 1999, 128: 359–360.