Original Article

Refraction

Cycloplegic Refraction in Children with Cyclopentolate versus Atropine

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ABSTRACT

Objective: The aim of this study is to evaluate the effectiveness of two cycloplegic drugs used in cycloplegic refraction in hyperopic children.

Study Design: Hospital based cross sectional study

Place and Duration of Study: This study was carried out at the Out-patient department of Ophthalmology Dow University of Health Science (Ohja campus), Karachi Pakistan from January 2011 to June 2011.

Materials and Methods: We instilled cyclopentolate 1% drops and refracted the patient followed after a few days with atropine eye drops 1% instillation and the results of both drugs were compared. The data are presented as mean and standard deviation (SD). Statistical analysis was performed using the SPSS software 19. A P-value of less than 0.05 was considered statistically significant.

Results: The total refractions were recorded after cycloplegia with atropine 1% and cyclopentolate 1% eye drops. Atropine refraction (mean4.05 D) was statically insignificantly comparing with cyclopentolate refraction (mean 3.315 D; P>0.05)

Conclusion: There is no significant difference in the cycloplegic refraction values between the two drugs hence cyclopentolate is a safe and effective drug to be used in cycloplegic refraction.

Key Words : Atropine, Cyclopentolate, cycloplegic refraction

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INTRODUCTION

Accommodation, quantified in diopters (D), is the process by which the eye changes refractive power to maintain a clear image (focus) on an object as its distance varies. This is achieved by changing the form of the crystalline lens using the ciliary body. The ciliary muscle contracts causing a reduction in the zonular tension which eventually changes refractive power of the eye.[1]

The amplitude of accommodation, declines with age, is the dioptric distance between the far point and the near point of accommodation. At the age of 3, the power of accommodation is 17 diopters which decreases at the age of 10 years to 14 diopters, at 25 years to 10 diopters, at 40 years to 6 diopters and by the age of 50 or less to 2 diopters. [2]

Cycloplegia is paralysis of the ciliary muscle, resulting in a reduction or loss of accommodation. There are many drugs which can cause cycloplegia. These are anticholinergic drugs that act by blocking the action of acetylcholine at the postsynaptic receptor site on the smooth muscle fiber of the ciliary body and iris sphincter muscle which are innervated by postganglionic parasympathetic nerve fibers. Mydriasis (dilation of the pupil) and loss of pupil reflex occurs along with cycloplegia. [1,3]

The best cycloplegics used should have the following properties: rapid onset, complete paralysis of accommodation, adequate duration of maximum cycloplegia, rapid recovery of accommodation, no or minimum local or systemic side effects. The two most commonly used cycloplegic agents are atropine and cyclopentolate. Although various studies have been done in order to compare the efficacy of these two agents, but until now none of them can be labeled as an ideal drug.[4]

The most powerful long-acting cycloplegic and mydriatic used in ophthalmology is atropine. It is an alkaloid (Belladonna) and is used in its water soluble form (atropine sulphate), and it is available as both drops and ointment at 0.5% or 1% strength. It Inhibits action of acetylcholine or other cholinergic stimuli at postganglionic cholinergic receptors, including smooth muscles, secretory glands, and CNS sites. One drop of atropine 1% gives maximal mydriasis in about 40 minutes and partial cycloplegia in about 3 hours. The effects may last between 8-15 days. Atropine is useful for assessing cycloplegic refraction, especially in children with esotropia since under-corrected hyperopia is suspected. It is also sometimes used to help children adjust to a recently prescribed high hyperopic correction.[5]

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Atropine is contraindicated in glaucoma and if there is a risk of precipitating glaucoma especially angle closure glaucoma. In some books it has been reported that atropine is particularly dangerous in patients with Down Syndrome and albinism. [6]Local side effects include allergy to alkaloids or atropine itself. Patient usually complains of excessive stinging on instilling the drops and the development of red and itchy rash on the eye lid skin. Ocular side effects include follicular conjunctivitis and contact dermatitis.[7] Systemic effects of atropine, which can be very dangerous, are tachycardia, tremors, delirium, convulsions, hot dry skin and even death. Therefore it should be used carefully in young children and elderly.[5]

The second widely used cycloplegic drug nowadays is cyclopentolate. Cyclopentolate, like atropine, in an anticholinergic agent and has same mechanism of action. Mydriatic effect of cyclopentolate starts in about 15 minutes but its maximum effect is achieved in about 30 minutes. It usually takes about 40 minutes for its cycloplegic effect. Recovery period of this drug is about 4-12 hours. [5]

Side effects of cyclopentolate are mostly dose dependent especially systemic effects. Commonly seen local sides include blurred vision, irritation, burning sensation and redness in eye. However, local allergic reactions are rare. Systemic effects of this drug are generally CNS related, which include visual hallucinations, slurred speech, ataxia, and seizures. Due to its CNS involvement, it is contraindicated in infants and young children with spastic paralysis or any brain damage. Being a cycloplegic drug, it should be strictly avoided in narrow angle glaucoma.[4,5,8]

Cycloplegia is necessarily used during ophthalmic examination for refractive errors in young children (particularly those who are high hyperopic), patients with strabismus (especially esotropia) and accommodative spasm. It is also indicated for the diagnosis of latent hyperopia in young adults (aged between 18-40 years). Cycloplegic refraction is rarely of use in older adults (above 40 years). [1,3]

Although the cycloplegic effect with atropine is superior to cyclopentolate (uncovers 0.4D more hyperopia), but it is less extensively used nowadays as compared to cyclopentolate. Because of its long duration of blurred vision as well as greater risk of toxicity, it has been now replaced by cyclopentolate.[1]

MATERIALS AND METHODS

This study was Conducted in an eye department of a tertiary care Center. A written consent was obtained from all the parents/guardians accompanying the children before they were enrolled in this study.

All children that were included in the study had a refractive power of more than 1.00DS and underwent a detailed ophthalmic examination along with a dilated fundus examination .Exclusion criteria included any known allergies or serious adverse reactions to the cycloplegic drugs, ophthalmic disease other than refractive error and/or strabismus and poor compliance.

All the study patients initially underwent cycloplegic refraction under cyclopentolate followed by atropine. A standard dose of cyclopentolate was used comprising of one drop of 1 % cyclopentolate instilled three times in each eye every five minutes after which the child was instructed to close his eyes gently to decrease the systemic absorption .Refraction was then performed by a skilled refractionist using WelchAllyn retinoscope NY USA .After an interval period of three days atropine sulphate 1% ointment was instilled three times a day for three consecutive days by the parents.

The patients were asked to come to the out patient department after three days and a detailed history was taken from the parents regarding side effects of these two drugs. This was followed with Retinoscopy which was performed on the fourth day by the same refractionist. The refractive data of the two drugs were compared using the power vector analysis.

RESULTS

A total of 50 children (100 eyes) with a mean ± SD age of (6 years± 2.739) range (2 years to 14 years) were included in this study. This is displayed in table 1 below. The total refractions were recorded after cycloplegia with cyclopentolate 1% and with Atropine 1% . Atropine (mean 4.05D) was statically insignificant in comparison with cyclopentolate (mean 3.315D)as the difference between the two was 0.735 D.

Table No.1: **Intraclass Correlation Coefficient**

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.986[a]	.978	.990	145.267	99	99	.000
Average Measures	.993[c]	.989	.995	145.267	99	99	.000
Two-way mixed effects model where people effects are random and measures effects are fixed.							
a. The estimator is the same, whether the interaction effect is present or not.							
b. Type A intraclass correlation coefficients using an absolute agreement definition.							
c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.							

ICC = 0.986 (P-value <0.001)

DISCUSSION

In order to diagnose and treat important ophthalmic disorders, especially in young children at the age of visual development or those with higher amplitudes of accommodation which cause refractive errors, full cycloplegia is required. [9]

The best cycloplegics used should have the following properties: rapid onset, complete paralysis of accommodation, adequate duration of maximum cycloplegia, rapid recovery of accommodation, no or minimum local or systemic side effects. The two most commonly used cycloplegic agents are atropine and cyclopentolate. Although various studies have been done in order to compare the efficacy of these two agents, but until now none of them can be labeled as an ideal drug.[4.10.11.12]

Although the cycloplegic effect with atropine is superior to cyclopentolate (uncovers 0.4D more hyperopia), but it is less extensively used nowadays as compared to cyclopentolate. Because of its long duration of blurred vision as well as greater risk of toxicity, it has been now replaced by cyclopentolate. [1]

However, some authors believe that atropine is the gold standard cycloplegic and should not be replaced. Ingram and Barr mentioned cyclopentolate as being less effective when compared with atropine at producing cycloplegia in 1 year old children. Rosenbaum et al concluded in their study that since 1.0 diopters or more hyperopia was uncovered by atropine in children, retinoscopy using atropine cycloplegia should be preferred. Goldstein and Schneekloth believe that refraction with 1% atropine ointment produces a significantly larger amount of hypermetropia than does refraction with a combination of cyclopentolate and tropicamide regardless of age, amount of hypermetropia, or size of the esotropia.[12,13,14]

Other studies done, comparing the cycloplegic effects of cyclopentolate with atropine, prove that cyclopentolate should be the drug of choice due to its shorter duration of action, less local and systemic complications and it is easier to administer. Khurana et al recommends cyclopentolate to be used as a routine cycloplegic in children subsequently comparing the mean residual accommodation measured after the use of cyclopentolate, homatropine and atropine. Celebi and Aykan suggested that the cyclopentolate cycloplegia applied to the patients with refractive accommodative esotropia (aged from 5 to 10) is sufficient to produce good cycloplegia .[15,16.17]

Many authors also say that cyclopentolate used alone in children 2 to 5 years old, is not effective particularly in those with esotropia with hyperopia more than 2D who must be repeatedly examined with atropine to detect latent hyperopia. [14,15,16,17,18]

Various other studies show that the mean difference between the amplitudes of accommodation with cyclopentolate and atropine is not very significant therefore cyclopentolate is favored. Salvesen and Køhler reported that the mean difference between atropine and cyclopentolate was only 0.23D. Nishizawa et al mentioned the difference in refraction between the combination drop (which included 0.5% cyclopentolate hydrochloride and 0.5% tropicamide) and 1% atropine was +1.00 dioptre or less. Similarly, Goldstein and Schneekloth's study revealed 1.25 D or more refractive power of hypermetropia with atropine. Rosenbaum et al stated that Atropine 1.0% revealed +0.34 diopters more hyperopia when compared with cyclopentolate 1.0%. Khurana et al observed that the mean difference between the two drugs was 0.26 +/- 0.14 with atropine. Other authors who favored this theory include Celebi and Aykan.[11.12,14,15,16,19]

This study included children between the ages 2 years and 14 years. No local or systemic side effects were seen with either atropine or cyclopentolate probably due to the limited sample size. Therefore according to this study, atropine 1 % in this population is safe and efficient.

Many earlier studies presented the importance of cycloplegia by atropine in children with strabismus. However this study showed the difference in cycloplegic refraction with atropine and cyclopentolate was not very significant, regardless patients had strabismus or not. Hence cyclopentolate should be considered as the drug of choice for cycloplegic refraction for children with or without strabismus as it is associated with less side effects.

CONCLUSION

There is no significant difference in the cycloplegic refraction values between the two drugs hence cyclopentolate is a safe and effective drug to be used in cycloplegic refraction.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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