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The Comparison between the Effect of Two Hours Atropinization Versus Three Days Atropinization on the Cycloplegic Outcome in Children

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Abstract

Background Cycloplegia abolishes the accommodative power by causing paralysis of ciliary muscle by anticholinergic drugs, which will inhibit stimulation of both ciliary muscle and sphincter pupillae causing cycloplegia and mydriasis. Atropine is widely used in cycloplegic refraction despite its potential toxicity.

Objective To evaluate the possible role of two hours atropinization versus three days atropinization on the cycloplegic outcome in children.

Methods This is a clinical interventional study that included fifty children aged two to seven years' old who attended Ibn Alhaitham Teaching Hospital from October 2012 to March 2013; manual refraction was done for each child after 120 minutes of two drops atropine 1% five minutes apart and refraction was repeated after three days of twice daily atropine 1% administration by the parents. T-test was used for means comparison.

Results Fifty patients (26 males, mean age 3.89 ± 1.3) were included in the study. Spherical equivalent results obtained after three days atropinization (M = 4.2, SD = 1.85) were significantly higher than those obtained after two hours atropinization (M = 3.84, SD = 1.64) ($t(49) = -6.60$, $p < 0.05$).

Conclusion Two hour atropinization was inferior to the standard three days atropinization as it has less cycloplegic effect and so it cannot be recommended based on the current evidence.

Keywords Atropine, cycloplegia, atropinization, refraction

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List of abbreviations: None

Introduction

Cycloplegia abolishes the accommodative power by causing paralysis of ciliary muscle by anticholinergic drugs, which will inhibit stimulation of both ciliary muscle and sphincter pupillae causing cycloplegia and mydriasis [(1)].

Cycloplegic examination will not only help us to determine the static refractive error, but also dilate the pupil allowing for full ophthalmological examination like detecting any opacity of the ocular media and for posterior segment examination [(1,2)].

Cycloplegic refraction helps determine full hyperopia in patients with accommodative esotropia and prevents overcorrection in myopic patients. It is also useful in prescribing correction in patients with limited cooperation

during subjective refraction and amblyopic patients who have chaotic accommodation [3].
Atropine can be used as drops or ointment. Maximal cycloplegia occurs at three hours and the recovery of accommodation will start after 3 days of discontinuing the drug and usually completed by 10 – 14 days [4].
The conventional recommendation of 3 drops of 1.0% atropine for either eye per day corresponds to 2-3 milligrams atropine per day (and this over three days) carries a risk of overdosing. Through the lacrimal ducts, a major proportion of the atropine passes into the nasopharyngeal cavity (where atropine is absorbed and can then act systemically). Consequently, it is not surprising that intoxications with atropine eye-drops have been repeatedly reported for decades. Also, atropine is contraindicated in patients with Down syndrome and albinism. The dosage of atropine borders on the toxic range. Additionally, parental compliance with the dosage schedule cannot be guaranteed [5-7].
Despite the fact that nowadays cyclopentolate is preferable for routine cycloplegia and has comparable results to atropine with less incidence of toxicity [2,8,9], many authors still consider atropine as the drug of choice for complete cycloplegia due to its strong cycloplegic action which may uncover additional 0.3–0.5 D of hyperopia in light, as well as deeply pigmented children with hyperopia and white children with esotropia [2,4].
The specification one drop of 0.5 or 1.0 percent atropine eye drops twice a day for three days was recommended by Duke-Elder 50 years ago [10]. There have not been many changes in the dosage recommendations for decades.
Parents who have to administer atropine at home for three days not uncommonly have difficulties in applying eye drops, and the ophthalmologist cannot always be certain whether correct application was carried out and whether full cycloplegia was really attained. Auffarth and Hunold had proposed a newer scheme for refractive measurements under atropine cycloplegia two hours after application of two drops of atropine (0.5% atropine children <2 years; 1.0% atropine children >2 years). This abbreviated scheme has the advantage of easier application by the untrained personnel, better compliance by the patients and their families, and the lesser chances of toxicity or overdose from prolonged atropine administration [11]. To our knowledge, no studies were conducted to evaluate the effectiveness of this abbreviated regimen apart of that of Auffarth and Hunold.
This study was carried to establish whether application of two eye drops of atropine and subsequent determination of refraction after two hours provided the same results as those obtained after conventional administration of atropine for three days.

Methods

This is a clinical interventional study conducted in the strabismus Unit at Ibn Alhaitham Teaching Hospital from October 2012 to March 2013. The sample was chosen by convenient randomization of the patients attending the Unit during the period of the study. All patients with strabismus and refractive error, whose age was from two to seven years, were invited to participate in this study with the exclusion of those with history of cardiac disease. A total of 50 patients, who agreed to participate, were enrolled in this study with consent from their parents.
Each patient received one drop of atropine 1% followed by another one after five minutes. Manual refraction was done after two hours and recorded. The patients and their families were instructed to apply further atropine drops that evening and to continue with twice daily atropine drops for the next two days. Refraction was recorded manually in the morning of the fourth day by the Unit refractionist.
The data were collected using a data collection form that was formulated for the purpose of the study. The data included age, sex, and presence of strabismus and/or refractive error, the refractive error recording after two drops

of atropine and the refractive error after three day atropinization.

Statistical analysis was done using IBM® SPSS® (Statistical Package for Social Sciences) Statistics version 21 on a Windows 7 Home Premium PC. Descriptive statistics were presented as (mean ± standard deviation) for the continuous variable (age, and the refractive error after atropinization) while the categorical variables (gender, presence of strabismus and/or refractive error) were presented as frequencies (numbers) and proportions (percentages). Level of significance was determined using t-test and a p value of ≤ 0.05 considered as significant difference.

Results

A total of 50 patients were enrolled in this study, 24 (48%) were males and 26 (52%) were females with almost equal male to female ratio as shown in table 1 and figure 1. The mean age of the study group was 3.86 ± 1.3 years and ranged from 2 -7 years, these findings and the age distribution are illustrated in table 1.

Table 1. Baseline characteristics of the study group

Variable		Value
Gender	Male n (%)	24 (48%)
	Female n (%)	26 (52%)
	Total	50 (100%)
Age (Years)	Mean ± Std deviation	3.89 ± 1.3
	Range	2 - 7

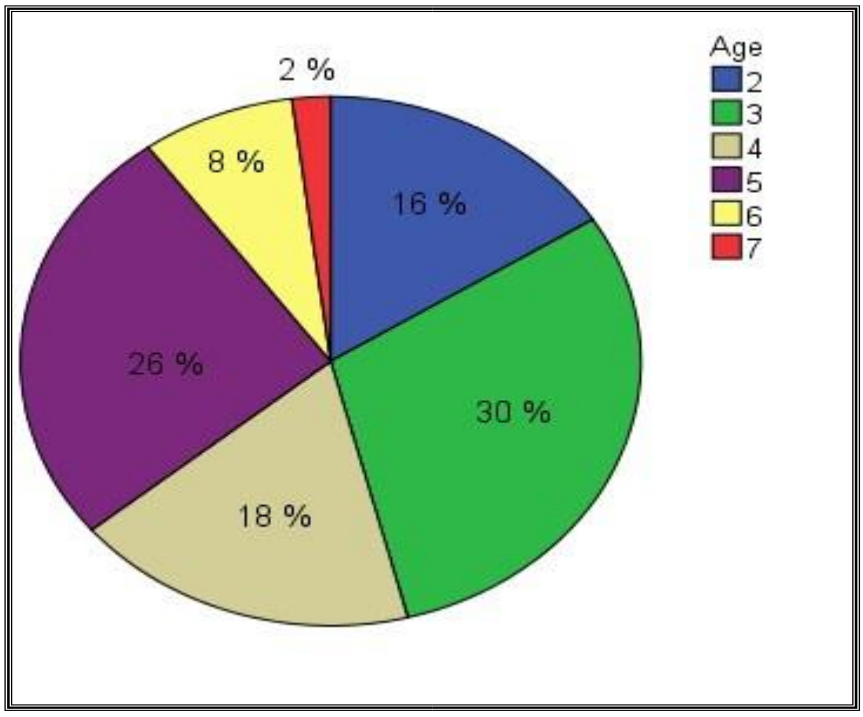

Figure 1. Age Distribution among sample

Among the study sample, 10 (20%) of the patients have strabismus and 13 (26%) have refractive error, while 27 (54%) have both strabismus and refraction as shown in table 2.

Table 2. Frequency of patients with strabismus and refractive error

Strabismus n (%)	Refractive Error n (%)	Both n (%)
10 (20%)	13 (26%)	27 (54%)

Table 3 illustrates the mean refraction obtained after two hours atropinization and that obtained after three days with 95% confidence interval.

Table 3. Mean, standard deviation and 95% confidence interval of two hours atropinization versus three day atropinization

	Mean (Diopter Sphere)	Standard deviation	95% Confidence Interval	
			Lower	Upper
Two Hours Atropinization	3.84	1.64	3.32	4.21
Three Days Atropinization	4.20	1.85	3.97	5.02

In figure 2, the frequency of the difference in the dioptric power between two hours and three days atropinization is shown. These results have demonstrated that in only 22% of patients had similar refraction with two hour atropinization as that of the three day atropinization. Nevertheless, it is quite obvious that 56% of the differences lies within 0.5 diopter and 82% within 1 diopter.

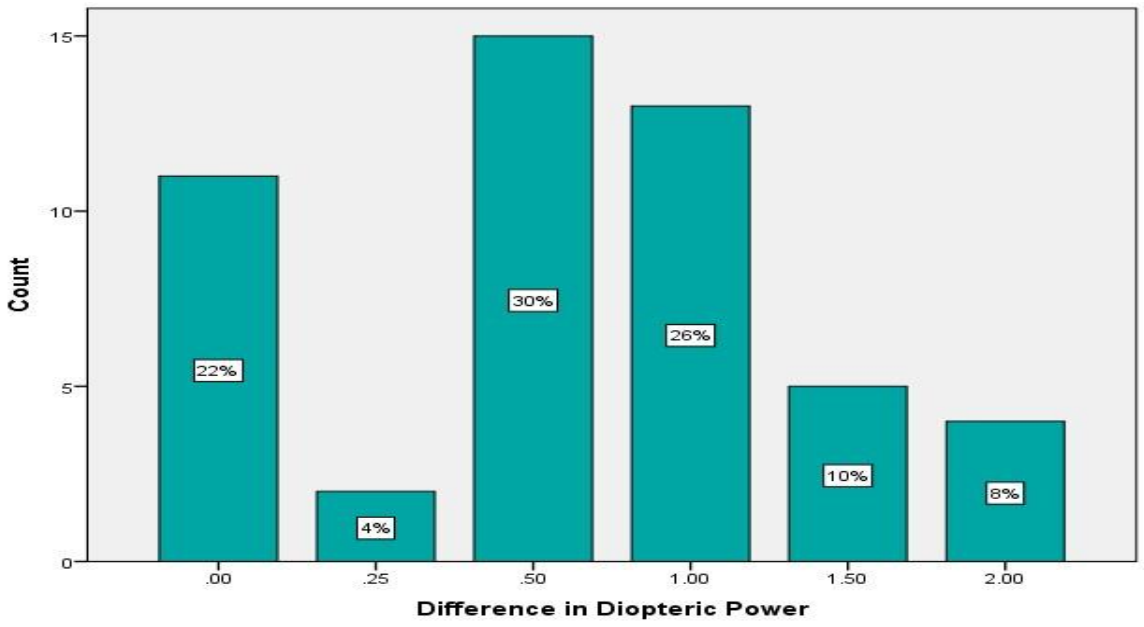

Figure 3. Difference in dioptric power between two hours and three day refraction

Spherical equivalent measured after two hours atropinization and after three days atropinization was analyzed using a dependent samples t-test. This revealed that spherical equivalent results obtained after three days atropinization (M = 4.2, SD = 1.85) were significantly higher than those obtained after two hours atropinization (M = 3.84, SD = 1.64) ($t(49) = -6.60$, $p < 0.05$).

Discussion

The results from this study showed statistically significant ($P \leq 0.05$) difference between two hour atropinization and three day atropinization. These results differ from those of Auffarth and Hunold, who had concluded that two hour atropinization has comparable results to three day atropinization without relying on statistical evidence. They assumed that with the presence of 0.5 diopter difference is enough to recommend the abbreviated scheme as this difference showed in about 80% of patient and they considered that a good correlation between the two methods [(11)].

In this study, the difference of 0.5 diopter was observed in only 56% of cases. This difference can be explained by the difference in obtaining refraction being manual in this study and automated refractometer in Auffarth and Hunold's study.

This study has its limitations. First, the small sample size may not demonstrate the true relation between the two regimens. Secondly, the use of manual refraction may have an impact on the results.

This study has concluded that two hour atropinization does not produce similar refraction as that of the standard three day atropinization.

This study recommends when atropine is used as a cycloplegic agent, the standard three day atropinization scheme will produce a more accurate refraction and is therefore it is recommended to continue using this scheme for cycloplgia with atropine till further studies confirm the non-inferiority of the abbreviated regimen.

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Author Contribution

All authors have contributed equally to this article.

Conflict of interest

Authors have nothing to disclose.

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