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The effect of atropine with different concentration (0.025% and 0.01%) on myopia programming

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In recent decades, myopia is becoming an epidemic. This is proven by a steady increase in the number of this type of refractive error around the world. One of the commonly used drugs for myopia is 1% atropine. However, frequent use of this drug has several side effects. The purpose of this study is to examine the effectiveness of 0.025% and 0.01% atropine compared with placebo for a year. The study involved 62 (124 eyes) children and adolescents between 4 and 14 years old with myopia of at least -1.0 and astigmatism up to 2.5 diopters. Considering the progression of the controlled spherical equivalent and the increase in the axial length of the eye in a year, 0,01% atropine was the most effective of all the applied concentrations. The pupil size in photopic and mesopic conditions increased and the accommodative amplitude decreased by 1.71± 2.61D, 0.28± 3.4D and 0.32± 2.91D in the groups 0.025%, 0.01% atropine and placebo respectively (p≤0.01).

Keywords: *Accommodative amplitude, atropine, myopia, spherical equivalent*

INTRODUCTION

In recent decades, myopia is becoming an epidemic. It is evidenced by the steady increase in the number of people with this type of refractive disorder around the world. B.A.Holden et al. (2016) suggest that by 2050 4,758 million people will have myopia, of whom 938 million will have high myopia (Sun et al., 2012).

An actual method of pharmaceutical control of myopia progression in children and adolescents is the use of antimuscarinic ophthalmic drugs, which are used in routine practice to dilate the pupil. Antimuscarinic ophthalmic drugs include Atropine (non-selective M-anticholinergic blocker) and Pirenzepine (selective M1-anticholinergic blocker, affecting mainly the ciliary body and having a minimal dilating effect on the pupil).

The first attempts to use atropine to prevent the progression of myopia were associated with the hypothesis of the excessive tension of the accommodation apparatus as the main cause of the development of this type of ametropia. In some contradiction with this hypothesis is the revealed fact of the effectiveness of atropine in preventing the development of myopia in an experiment on chickens, in which accommodation is mediated by n-cholinergic receptors (McBrien et al., 1993). In recent years, the possible stabilizing effect of atropine on the course of myopia has been associated with changes in the posterior segment of the eye.

The body of evidence shows that dopamine is one of the retinal neurotransmitters involved in the signaling cascade that controls eye growth (Feldkaemper and Schaeffel, 2013). For example, McBrien et al found that dopamine levels were reduced in the eyes of myopic deprivation chickens and mammals (McBrien et al., 2001). N.Schwahn et al. established that atropine administered intravitreally increased dopamine release from the retina in myopic deprivation chicks (Schwahn et al., 2006). In addition to dopamine, nitric oxide (NO) may play a role in the mechanism of atropine's effect on the

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progression of myopia (Carr and Stell, 2016).

A series of studies on chickens revealed that of the many m-cholinergic receptor antagonists (including non-selective ones), only atropine, pirenzepine and oxyphenonium influenced the progression of deprivation myopia (Carr and Stell, 2016; Luft et al., 2003). Based on this, it has been suggested that the effect of atropine on preventing the development of myopia may not be associated with an effect on m-cholinergic receptors (Carr and Stell, 2016). It should be noted that chicken receptors have a different affinity for drugs as the mechanism of action has been studied only on mammalian receptors. Despite the data above, the question of the pharmacological mechanism of action of atropine on myopia's progression, which is unrelated to the effect on the accommodative apparatus of the eye, remains open and requires further study.

In turn, 1% atropine, which is widely used in preventing the development of myopia, has a number of negative effects on the eye. This includes photophobia due to persistent mydriasis and reduced ability to work at close range due to cycloplegia. The use of 1% atropine in both eyes might be photochromic, multifocal lenses and complications are possible (e.g. dryness and itching in the eyes, dry mouth and throat, constipation, redness and itching of the skin, difficulty urinating). Such side effects are not observed when using atropine at lower concentrations.

The purpose of the study was to investigate the efficacy of atropine at concentrations of 0.025% and 0.01% compared with placebo over one year.

MATERIALS AND METHODS

Sixty-two (124 eyes) children and adolescents aged from 4 to 14 years with myopia of at least -1.0 and astigmatism of up to 2.5 diopters participated in the study. Thirty-five girls (70 eyes, 56.4%), 27 boys (54 eyes, 43.6%); Twenty-nine (58 eyes, 46.8%) participants were diagnosed with a mild degree, 33 people (66 eyes, 53.2%) had an average degree of myopia. Subjects received 0.025% and 0.01% atropine or placebo eye drops. Drops were prescribed 1 time at night in both eyes for a period of 1 year. We studied: cycloplegic refraction (Plusoptix apparatus), the axial length of the eye (SonomedPacScan 300), accommodation amplitude, pupil diameter and maximum corrected vision. In addition, visual acuity was studied, tonometry (Canon Full Auto Tonometer TX-F), ophthalmoscopy tests were performed. Studies were conducted at the beginning and then 2 weeks, 4 months, 8 months and 12 months into the study. The main results were changes in sphere equivalent, eye length and the difference between groups. Statistical processing was performed in Statistics 20.

RESULTS

Pupil size under photopic and mesopic conditions was increased by 0.69± 0.8 mm and 0.43± 0.61 mm, respectively, in the 0.025% atropine group, by 0.59± 0.9 mm and 0.25± 0. 56 mm in the 0.01% atropine group and in the placebo group, respectively, 0.15±1.09 mm and 0.3± 0.55 mm ($p \leq 0.01$).

After 1 year, the changes in the spherical equivalent averaged -0.59±-0.55D, -0.54± 0.61 and -0.81±0.57D, respectively, in the groups ($p \leq 0.01$) (Table 1), with the corresponding mean increase in axial length equal to +0.3±0.25 mm, 0.27±0.2 mm, 0.39±0.29 mm and 0.51± 0.22 mm ($p \leq 0.01$).

Table 1. Average change in spherical equivalent (-) (D)

	2 weeks	**4 months**	**8 months**	**1 year**
0.025% Atropine	0.60±0.50	0.58±0.55	0.61±0.51	0.59±0.55
0.01% atropine	0.59±0.55	0.57±0.59	0.60±0.55	0.54±0.61
placebo	0.98±0.56	0.91±0.54	0.90±0.55	0.81±0.57

The accommodative amplitude was less by 1.71±2.61D, 0.28±3.4D and 0.32±2.91D, respectively, in the groups (0.025%, 0.01% atropine and placebo) ($p \leq 0.01$). The pressure was constant in all groups.

CONCLUSIONS

On the basis of the conducted research, the following conclusions can be drawn:

1. In groups of 0.25 and 0.01% atropine, a slowdown in the progression of myopia was observed in proportion to the concentration of the drug.
2. All concentrations were well tolerated without side effects that impair the quality of life associated with vision.
3. Of all the applied concentrations 0.01% atropine was the most effective, given the progression of controlled spherical equivalent and increase in axial length of the eye over a year.

REFERENCES

Carr B., Stell W. (2016) Nitric oxide (NO) mediates the inhibition of form-deprivation myopia by atropine in chicks. *Sci Rep*., **6(9):** 1-13.

Feldkaemper M., Schaeffel F. (2013) An updated view on the role of dopamine in myopia. *Exp. Eye Res*., **114:**106-119.

Holden B.A., Fricke T.R., Wilson D.A., Jong M., Naidoo K.S., Sankaridurg P., Wong T.Y., Naduvilath T.J., Resnikoff S. (2016) Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. *Ophthalmol.*, **123(5):**1036-1042.

Luft W., Ming Y., Stell W. (2003) Variable effects of previously untested muscarinic receptor antagonists on experimental Myopia. *Invest. Ophthalmol. Vis. Sci.*, **44(3)**:1330.

Luft W.A., Ming Y., Stell W.K. (2003) Variable effects of previously untested muscarinic receptor antagonists on experimental myopia. *Invest. Ophthalmol. Vis. Sci.*, **44(3):** 1330-1338.

McBrien N., Cottriall C., Annies R. (2001) Retinal acetylcholine content in normal and myopic eyes: A role in ocular growth control *Vis.Neurosci.*, **18(4):**571-80.

McBrien N., Moghaddam H., Reeder A. (1993) Atropine reduces experimental myopia and eye enlargement via a nonaccommodative mechanism. *Invest. Ophthalmol. Vis. Sci.*, **34(1):** 205-215.

Schwahn H., Kaymak H., Schaeffel F. (2000) Effects of atropine on refractive development, dopamine release, and slow retinal potentials in the chick. *Vis.Neurosci*.,**17(02):**165-176.

Sun J., Zhou J., Zhao P., Lian J., Zhu H., Zhou Y., Sun Y., Wang Y., Zhao L., Wei Y., Wang L., Cun B., Ge S., Fan X. (2012) High prevalence of myopia and high myopia in 5060 Chinese university students in Shanghai. *Invest. Ophthalmol. Vis. Sci*., **53:**7504-7509.

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