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Will the long-term use of atropine eye drops in children increase the risk of dry eye?

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ABSTRACT

In recent years, some studies indicates that atropine eye drops is one of the most effective interventions for myopia. Due to large demand, the use of low-concentration atropine eye drops to reduce myopia progression is popular in China. Considering that the underlying mechanism of atropine eye drops in controlling the progression of myopia is still unclear, it is reasonable to pay enough attention to whether the long-term use of atropine eye drops in children will increase the risk of dry eye.

Introduction

Myopia refers to the refractive state in which the focus falls in front of the retina after the parallel rays are refracted by the refractive system of the eye under the relaxed state. Currently, approximately 90% of Chinese adolescents and young people have myopia. The incidence of myopia in children and adolescents in China and other Asian countries is increasing year to year, and the onset age is getting younger; therefore, myopia has become a serious public health problem [1].

Because the pathogenesis of myopia has still not been fully elucidated, currently, there is no effective treatment method [2]. In clinical practice, treatment mainly focuses on how to reduce myopia progression. In terms of axial length, the literature has shown that atropine, orthokeratology, peripheral defocus modifying contact lenses, pirenzepine, and progressive addition spectacle lenses were effective [3]. The most effective intervention is atropine. Due to large demand, even though the National Medical Products Administration (NMPA, China) has not formally approved low-concentration atropine eye drops for the control of myopia in children, the use of atropine eye drops is popular in mainland China through foreign purchasing or self-preparation.

The hypothesis

The safety of long-term application of atropine eye drops in children needs to be further evaluated. Notably, will the long-term application of atropine in children cause complications, such as dry eye? Atropine should not be abused during the prevention and treatment of myopia.

Evaluation of the hypothesis

Some common complications of topical application of atropine eye drops have been reported in previous studies, such as dilated pupils, photophobia, blurred vision, myopic rebound after drug withdrawal, allergies, and abnormal accommodation [4–7]. Currently, there is no definitive conclusion on whether long-term use of atropine in children affects the meibomian glands and tear film, thereby causing dry eye.

Animal experiments have shown that 1% atropine eye drops can quickly induce dry eye symptoms in rabbit eyes, this effect is weakened after a few weeks [8]. The effect of long-term (e.g., 1 year or more) topical application of atropine on experimental animals has not been reported. The concentrations (0.01–0.02%) of atropine used in the prevention of myopia in children are low; however, given the long duration of medication needed and young children as the recipients, it is necessary to be cautious about whether long-term medication use induces complications, such as dry eye.

In a preliminary study on the effect of atropine eye drops on children as measured using LipiView, we found that some children with long-term atropine treatment had obvious dry eye symptoms and that some children had abnormal morphology in the meibomian glands and tear film. Notably, this preliminary study had the following limitations. First, the study design could not distinguish whether changes in the meibomian glands and tear film were caused by atropine itself or by a preservative in the drug preparation. In addition, some children in the preliminary study also used orthokeratology to control the progression of myopia, which might also affect the meibomian glands and tear film. Finally, the sample size of this study was small, and many cases lacked basic data prior to drug use. Therefore, large-sample clinical prospective randomized controlled studies are needed to confirm the

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results.

Discussion

At present, the application of atropine in mainland China for the prevention and control of myopia has several characteristics: off-label drug use, use without a prescription, long-term use, and large proportion of atropine use combined with other treatments, such as orthokeratology.

1. Off-label drug use: At present, the China NMPA has not approved low-concentration atropine eye drops for the control of myopia in children. Therefore, its application in mitigating the progression of myopia is off-label drug use.
2. Use without a prescription: During the actual course of medication, some patients or institutions often purchase atropine to prepare eye drops through other channels without a prescription. Improper dispensing or contamination of the drug could bring some unknown risks.
3. Long-term use: Currently, there is no large-scale survey data of medication habits; however, more than two years of medication use is very common, and a considerable percentage of parents extended the medication use time in children after observing the effect of slowing myopia development.
4. In combination with other treatments, such as orthokeratology: For the purpose of pursuing better prevention and control effects of myopia, some ophthalmologists and parents are keen on adopting combination therapy. The most common combination regimen is atropine with orthokeratology.

The effectiveness of atropine eye drops in controlling the progression of myopia has been confirmed by many studies, but the underlying mechanism is still unclear, and long-term side effects and complications, such as an abnormal visual function or dry eye are not clear [2–7]. Therefore, caution should be used prior to clinical application. To ensure the safety of medication for children, its use is only recommended when myopia progression is fast or other methods of myopia control are not suitable or are not effective. In addition, binocular visual function and dry eye examination should be performed prior to prescribing medication, and atropine should not be used as routine medication for the prevention and control of myopia and as preventive medication for children who have not yet suffered from myopia. Prior to prescribing atropine, doctors should inform the child and parents of potential adverse reactions and closely observe the child's eye conditions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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