Convergence excess consecutive esotropia associated with 0.01% atropine eye drops usage in patients operated for intermittent exotropia

Mihir Kothari¹,², Mohini Modak¹, Heena Khan¹, Shaifrin Jahan¹, Meghna Solanki¹, Vivek Rathod³

To report convergence excess esotropia (CEET) following 0.01% atropine eye drops (Low dose atropine [LDA]). Children who developed CEET that resolved promptly after discontinuation of LDA are described. Three myopes aged 5.3 ± 1.2 years and mean sphere -4.5D were included. All were operated for intermittent exotropia earlier. Mean esotropia was +28.3PD for near and +10.6PD for distance. LDA induced high AC/A ratio and fusion normalized in 3 weeks after discontinuation of LDA. LDA should be used with caution in patients with esophoria or previously operated for intermittent exotropia. Any evidence of the emergence of a CEET should warrant discontinuation of LDA.

Key words: Anticholinergic, atropine, convergence excess, esotropia, progressive myopia

According to recent studies, 0.01% atropine eye drop (LDA) has become popular first-line treatment for progressive childhood myopia.¹,² In spite of +3D to +6D decrease in accommodation with LDA, hypoaccommodation is seldom of any clinical concern.²,³

In this study, we present hitherto unreported complication of LDA induced convergence excess esotropia (CEET) due to hypoaccommodation following its application once at night. The esotropia promptly normalized and the fusion was restored in all the children after discontinuation of LDA.

Table 1: Clinical profile of the patients who developed esotropia with LDA

| Age in years | Patient 1 | Patient 2 | Patient 3 |
|--------------|-----------|-----------|-----------|
| Gender       | Male      | Female    | Female    |
| Right eye sphere in diopters | -6.50    | -2.25   | -3.50    |
| Left eye sphere in diopters    | -7.00    | -2.0    | -4.0     |
| Best corrected distance visual acuity (log MAR) | 0.1  | 0 | 0.1 |
| Total duration of use of LDA | 16 months | 4 months | 4 months |

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

Cite this article as: Kothari M, Modak M, Khan H, Jahan S, Solanki M, Rathod V. Convergence excess consecutive esotropia associated with 0.01% atropine eye drops usage in patients operated for intermittent esotropia. Indian J Ophthalmol 2020;68:653-6.
Accommodation improved in patient 1 and patient 2 after stopping LDA [Table 2]. However, binocular and monocular accommodative functions could not be measured in patient 3.

**Discussion**

A modest reduction in accommodation in children using LDA is common and generally well tolerated.\(^{[5-6]}\) However, the accommodative abnormalities induced due to long-term use of LDA may affect accommodation and convergence relationship resulting in CEET in children, especially with pre-existing fusional anomalies.

In our study, bedtime instillation of LDA in the patients, who were monofixators postoperatively, resulted in hypoaccommodation induced excessive innervational drive to accommodate, leading to manifest esotropia with an increased AC/A ratio causing decompensation of their tenuous fusion. Similarly, a previous study by Lyu, \textit{et al.}\(^{[7]}\) reported a median increase of +10PD in 38% of children with pre-existing esodeviation under the effect of partial cycloplegia using 0.5% tropicamide and 0.5% phenylephrine. A maximum increase of +25PD was reported which recovered after the effect of cycloplegia subsided. A similar phenomenon (CEET) was observed with the use of systemic anticholinergics viz. scopolamine patch for sialorrhoea in cerebral palsy,\(^{[8]}\) amitriptyline and oxybutynin for nocturnal enuresis,\(^{[9-11]}\) and haloperidol and benzatropine mesylate for Tourette syndrome.\(^{[12]}\)

The AC/A ratio is believed to be inborn and remains constant throughout life but varies greatly amongst individuals.\(^{[13]}\) Cycloplegic agents interfere with accommodation but if it is retained due to incomplete cycloplegia, it induces a reflex convergence by excessive innervational accommodative effort, thus increasing esodeviation.\(^{[14]}\) Conversely, if cycloplegia is complete and present for an extended duration, accommodative efforts are suspended causing complete abolition of an accommodative component of esotropia. This is typically seen with the use of 1% atropine drops in patients with fully refractive accommodative esotropia [Fig. 5].\(^{[15]}\)

Some factors that were common in all our patients and previous studies were 1) pre-existing esophoria and 2) prompt reduction in esotropia after discontinuation of the drops. Although two patients in our study were left with significant esotropia, future follow-ups may show a further reduction of esotropia provided their LDA is stopped. Inability to recognize this side effect of LDA could cause permanent contracture of medial rectus leading to incomplete resolution of esotropia despite its discontinuation. Such a phenomenon
Case Reports

is often reported in presbyopes, which could happen due to defects in vergence adaptation (neurologic) or muscle length adaptation (anatomic). Because the children were young, no forced duction test (FDT) was performed on medial rectus. Inference of a positive FDT is that the long-term use of LDA caused muscle length adaptation (medial rectus shortening) in response to increased accommodative effort induced convergence excess.

Although none of our patients had convergence excess type of intermittent exotropia preoperatively, it is advisable to discontinue LDA in such patients scheduled for squint surgery.

The last point of contention is possible therapeutic use of LDA for patients with low AC/A ratio viz. convergence insufficiency. Similar to once used cholinergic agents viz echothiopate, carbachol, and isoflurophate for convergence excess esotropia, it is possible that LDA may improve AC/A ratio in patients with convergence insufficiency. This question is best left for future research.

To summarize, LDA should be used cautiously and after a detailed discussion with the parents regarding it’s off label use for retardation of myopia progression more so in the patients having pre-existing fusional anomalies (or other ocular comorbidity). Any evidence of the development of a CEET or any other side effect should warrant immediate discontinuation of LDA. Further research is needed to determine whether bifocal glasses or progressive addition lenses with LDA or switching to 1% atropine eye drops could prevent a recurrence of CEET while retaining the therapeutic benefits of atropine.[17,18]

Table 2: Improvement in accommodative functions after cessation of 0.01% atropine eye drops in patients with convergence excess esotropia

| Patient 1: | On Low dose Atropine | After stopping low dose atropine |
|------------|----------------------|-------------------------------|
| Negative relative Accommodation | +4 | +4 |
| Positive relative accommodation | -1.50 | -2.50 |
| Binocular accommodation facility | 8 cycles per minute (cpm) | >15 cpm |
| Right eye accommodation facility | 3 cpm | 14 cpm |
| Left eye accommodation facility | 3 cpm | 14 cpm |

| Patient 2: | | |
|------------|----------------------|-------------------------------|
| Binocular accommodation facility | Not reliable | Not reliable |
| Binocular near point of accommodation | 14 cm | 12 cm |
| Right and left eye monocular near point of accommodation | 14 cm | 12 cm |

Figure 4: Line diagram demonstrating the effectiveness of 0.01% atropine (LDA) in patients with CEET

Figure 5: Picture of 5-year-old girl with fully refractive accommodative esotropia in the left eye (a) and resolution after extended and complete cycloplegia produced with 1% atropine eye ointment (b)

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients
understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Kesarwani SS; Mumbai Group of Paediatric Ophthalmologists and Strabismologists. Consensus statement and guidelines for use of dilute atropine sulphate in myopia control. Indian J Ophthalmol 2019;67:461-3.
2. Chia A, Chua WH, Cheung YB, Wong WL, Lingham A, Fong A, et al. Atropine for treatment of childhood myopia: Safety and efficacy of 0.5%, 0.1% and 0.01% doses. Ophthalmology 2012;119:347-54.
3. Cooper J, Eisenberg N, Schulman E, Wang FM. Maximum atropine dose without clinical signs or symptoms. Optom Vis Sci 2013;90:1467-72.
4. Chia A, Lu QS, Tan D. Five-year clinical trial on atropine for the treatment of myopia 2: Myopia control with atropine 0.01% eye drops. Ophthalmology 2016;123:391-9.
5. Nishiyama Y, Moriyama M, Fukamachi M, Uchida A, Miyashiro H, Kurata A, et al. Side effects of low dose atropine. Nippon Ganka Gakkai Zasshi 2015;119:812-6.
6. Loughman J, Flitcroft DI. The acceptability and visual impact of 0.01% atropine in a Caucasian population. Br J Ophthalmol 2016;100:1525-9.
7. Lyu Il, Park KA, Oh SY. Increase in esodeviation under cycloplegia with 0.5% tropicamide and 0.5% phenylephrine mixed eye drops in patients with hyperopia and esotropia. BMC Ophthalmol 2017;17:247.
8. Good WV, Crain LS. Esotropia in a child treated with a scopolamine patch for drooling. Pediatrics 1996;97:126-7.
9. Cioplean ED, Camburu LR. Transitory consecutive esotropia after amitriptyline treatment for nocturnal enuresis - case report. Rom J Ophthalmol 2015;59:116-8.
10. Wong EY, Harding A, Kowal L. Oxybutynin-associated esotropia. J AAPOS 2007;11:624-5.
11. Kaneko K, Fujinaga S, Ohtomo Y, Shimizu T, Yamashiro Y. Combined pharmacotherapy for nocturnal enuresis. Pediatric Nephrol 2001;16:662-4.
12. Oh SY, Shin BS, Lee YH, Lee AY, Kim JS. Benztrpine-induced esotropia and mydriasis. J Neuroophthalmol 2007;27:312-3.
13. Christoferson KW, Ogle KN. The effect of homatropine on the accommodation-convergence association. AMA Arch Ophthalmol 1956;55:779-91.
14. Morgan MW, Peters HB. Accommodative convergence in presbyopia. Am J Optom 1951;28:3-6.
15. Kothari M, Manurung F, Paralkar S. Use of atropine to predict the accommodative component in esotropia with hypermetropia. Indian J Ophthalmol 2011;59:487-90.
16. Wright WW, Gotzler KC, Guyton DL. Esotropia associated with early presbyopia caused by inappropriate muscle length adaptation. J AAPOS 2005;9:563-6.
17. Chua WH, Balakrishnan V, Chan YH, Tong L, Ling Y, Quah BL, et al. Atropine for the treatment of childhood myopia. Ophthalmology 2006;113:2285-91.
18. Kothari M, Rathod V. Efficacy of 1% atropine eye drops in retarding progressive axial myopia in Indian eyes. Indian J Ophthalmol 2017;65:1178-81.