Original Article

Nasolacrimal duct obstruction: Does it really increase the risk of amblyopia in children?

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Purpose: To report the prevalence of amblyopia risk factors in children with congenital nasolacrimal duct obstruction. **Methods:** A retrospective review of records of children with the diagnosis of congenital nasolacrimal duct obstruction (NLDO), who underwent probing from January 2009 to October 2011, was done. All of them underwent a complete ophthalmic evaluation including cycloplegic refraction and strabismus evaluation before probing. **Results:** A total of 142 children were included in this study. The mean age at presentation was 22.38 months (sample standard deviation (SSD) - 15.88). Amblyopia risk factors were defined according to two sets of guidelines: The American Association for Pediatric Ophthalmology and Strabismus (AAPOS) referral criteria guidelines and the new AAPOS Vision Screening Committee guidelines. Twenty-eight (20%) children were found to have some form of amblyopia risk factor based on the referral criteria prescribed by AAPOS. However, on applying modified guidelines described by Donahue *et al*., to analyze the same cohort, 21 children were found to have amblyogenic risk factors. Of these 28 children, 13 had significant astigmatism (>1.50 D), 8 children had hypermetropia (>3.50 D), and six children had anisometropia (>1.50 D). One child had significant cataract (media opacity >1 mm). None of the children in this series had either myopia or strabismus. **Conclusion:** Prevalence of amblyopia risk factor was found to be 20% in our study based on the older guidelines; however, it reduces to 14.78% by applying the modified guidelines. Despite this reduction, importance of a comprehensive ophthalmic examination including cycloplegic refraction in all children presenting with NLDO cannot be overstated. A close follow-up of these children is also essential to prevent the development of amblyopia.

Key words: Amblyopia risk factors, anisometropia, congenital nasolacrimal duct obstruction

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Congenital nasolacrimal duct obstruction (CNLDO) affects up to 20% of infants and is one of the most common problems encountered in a pediatric ophthalmology practice.[1] Presenting features of CNLDO include constant epiphora and intermittent discharge involving one or both the eyes. It is usually considered a benign disease as far as visual development is concerned. Most of these children (90%) undergo spontaneous resolution in the 1st year of life, whereas the remaining children continue to have symptoms beyond 1 year of age.[2-4] Normal development of visual system in early life requires the presence of a sharply focused retinal image. It is not known if persistent tearing has any role in the visual development of children. Although there are reports of anisometropic amblyopia associated with CNLDO, studies have remained largely inconclusive.[5,6] Hypothetically, persistent watering in CNLDO can lead to blurring of vision and form-deprivation amblyopia during the sensitive period of visual development. Hence, disorders of binocular function are likely to be more common in this group of children.[7,8] The objective of this study was to describe the prevalence of factors which can potentially lead to amblyopia in children with CNLDO.

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Methods

This is a retrospective case series. The medical records of all children below 5 years, diagnosed with CNLDO and who underwent probing from January 2009 to October 2011, were retrospectively reviewed. The diagnosis of CNLDO was made clinically, based on the presence of an increased tear film height with matted lashes and regurgitation on pressure over the lacrimal sac. Probing, according to our institutional protocol, was performed only if the child was at least 1 year of age or older. Younger children were initially managed by conservative approach of Criggler's massage till they were at least 1 year old. Early probing was done in situations where intraocular surgery was planned, or there was recurrent episode of acute dacryocystitis.

A total of 142 children were included in the study. Data on the patients' gestational age, birth weight, age at diagnosis, and associated systemic diseases were noted. Children with low birth weight (1500–2500 g), history of prematurity, and those who had a family history of amblyopia were excluded

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from this study, as these are independent risk factors for the development of amblyopia. A comprehensive ophthalmic examination was done in all these children, which included visual acuity, cycloplegic refraction, cover test, and a detailed anterior segment and fundus evaluation. Children <2 years were dilated with homatropine and tropicamide and children more than 2 years were dilated with cyclopentolate, and tropicamide after ruling out systemic contraindications.

Amblyopia risk factors were identified in accordance with the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) referral criteria guidelines[9] which include: anisometropia - spherical/cylindrical >1.5 D, any manifest strabismus,hyperopia >3.5D in any meridian, myopia magnitude >3.0D in any meridian, any media opacity>1 mm in size, astigmatism >1.5 D at 90 or 180 or more than 1D in oblique axis, ptosis 1mm marginal reflex distance

The revised guidelines for amblyopia risk factors (ARFs) in preschool children, proposed by Donahue *et al*.[10] were more age specific. According to the newer guidelines, magnitude of refractive error associated with increased risk of amblyopia was as follows: In children aged 12–30 months, astigmatism of 2.0 D, hyperopia of 4.5 D, myopia of 3.5 D, and anisometropia of 2.5; in children aged 31–48 months, astigmatism of 2.0 D, hyperopia of 4.0 D, anisometropia of 2.0 D, and myopia of 3.0 D; and children older than 48 months, astigmatism of 1.50 D, hyperopia of 3.50 D, anisometropia of 1.5 D, and myopia of 1.5 D. The nonrefractive risk factors included any media opacity more than 1 mm and any form of manifest strabismus of more than 8 PD.

Results

Of the 142 children included in the study, 94 were males and rest 48 were females. The mean age at presentation was 22.38 months (SSD - 15.88 months). CNLDO was present in the right eye in 65 children (45.77%), left eye in 57 children (40.14%), and was bilateral in 20 (14.08%). Amblyopia risk factors were identified in 28 children (20%) based on the older criteria. Among these 28 children, CNLDO was distributed equally on the right and left side in 10 patients each and was bilateral in 8 patients. The mean age of children with CNLDO who had amblyopiagenic risk factors (ARF) was 3.25 years. The most common refractive error, as far as potential risk of amblyopia is concerned, was astigmatism seen in 13 subjects, followed by hypermetropia in 8 and anisometropia was seen in 6 patients. However, when we reanalyzed our dataset using the revised guidelines proposed by Donahue *et al*. published in 2013, only 21 (14.78%) children had some form of ARF [Table 1]. One of the aim of our study was to compare the Amblyogenic factors applying both the criteria, the reason why both the criteria have been used. One child had a visually significant cataract. None of the children in our cohort had significant myopia, strabismus, or ptosis. There was no correlation between the laterality of CNLDO and the degree of refractive error in children with either hypermetropia or astigmatism. Interestingly, in all children with unilateral CNLDO and anisometropia, the eye with NLDO was more ametropic compared to the fellow eye [Table 2]. Mean follow-up was 9.54 months. Of the 28 children identified with risk factors, 2 developed amblyopia requiring occlusion and 3 children were lost to follow-up despite significant anisometropia. Seven children were prescribed glasses. The remaining children were kept under regular monitoring. The child with cataract underwent cataract extraction and is under regular follow-up.

Table 1: Comparison of ARF applying the older and the newer guidelines refractive ARF

Age in months	Number of children with ARF applying the older guidelines	Number of children with ARF applying the newer guidelines
12-30	12	7
31-48	4	2
>48	11	11
Total	27	20

Nonrefractive ARF – One child had significant lens opacity of >1 mm

Table 2: Laterality of congenital nasolacrimal duct obstruction in children with anisometropia

Eye	Right eye	Left eye
OS	+1.25/−2.25×180	+3.00/−1.75×180
OD	+8.50 DSPH	+1.50 D
OS	+1.00/−0.50×180	+2.25/−3.00×180
OD	+4.50 DSPH	+2.25 D
OS	+1.00/−0.50×180	+2.75/−0.50×180
OD	+1.25/−2.25×180	−3.00/−1.75×80

CNLDO: Congenital nasolacrimal duct obstruction, OS: Oculus sinister, OD: Oculus dextrus, D: Dioptre

Discussion

CNLDO has been speculated to have an increased risk of amblyopia for various reasons in the past. In the recent years, there have been series of articles supporting this hypothesis. Most of these studies have applied the older guidelines used to define amblyogenic risk factors. However, does CNLDO really increase the risk of amblyopia or is it dependent on the criteria applied to define these risk factors? This prompted us to compare the prevalence of the risk factors applying both sets of guidelines available in the literature, in children with CNLDO.

Amblyopia is defined as reduced visual acuity in one or both the eyes resulting from reduced visual input or abnormal binocular interaction early in life, in the absence of any organic cause. It is one of the most common causes of unilateral visual impairment in children, with a prevalence of 2–5%.[11] Apart from refractive error, strabismus, and sensory deprivation, there are other independent risk factors associated with amblyopia. These include heredity, low birth weight (1500–2500 g), mental disability, craniosynostosis, hydrocephalus, and blepharophimosis, to mention a few.[12-17]

There has been a limited investigation into the association of CNLDO with other visual disorders. Studies in primates have shown two sensitive periods in the development of neurological substrate for binocular vision. The first stage extends from birth to 8 weeks and the second stage extends from 8 weeks to 12–18 months.[7] Clear focusing of the images on the retina is very vital for emmetropization. Persistent unilateral watering and discharge leading to a blurring of vision during this period of competitive interaction may be sufficient enough

to disrupt emmetropization and result in an increased incidence of strabismus, anisometropia, and amblyopia.

Ellis *et al*. have looked into the hypothesis that tear film disturbance in CNLDO may interfere with visual maturation.[8] They compared the overall incidence of ametropia, anisometropia, or astigmatism in CNLDO with the control group. They found no evidence to prove that disruption by tear film in CNLDO interfered with emmetropization or developing ocular alignment.

Chalmers and Griffith in their retrospective study of 210 patients with CNLDO found that 3.9% of children with unilateral NLDO developed amblyopia in the affected eye.[6] About 4.65% of these children subsequently went on to develop strabismus. In children with bilateral NLDO, 1.25% went on to develop amblyopia.

In 2003, the Vision Screening Committee of the AAPOS revised the guidelines which primarily defined the quantum of refractive error which was sufficient to put the child at risk for the development of amblyopia – or in other words the "Amblyopia Risk factors". These guidelines are based on stronger evidence and consensus. The guidelines proposed by Donahue *et al*. identified those children who are more at risk for developing amblyopia compared to those who had low risk.

Based on the older guidelines, the prevalence of ARF in the normal population is reported to be around 15–20%;[18-20] however, a majority of these children do not develop amblyopia. Matta and Silbert observed an increased prevalence of amblyopia risk factor in children with CNLDO.[21] They found that 22% of children under 3 years of age with CNLDO had amblyopiagenic risk factor as defined by the older guidelines. Sixty-three percent of these children developed amblyopia requiring treatment. This observation has echoed in other studies all over the globe including our study. Matta *et al*. found an increased incidence of significant astigmatism.[22] In their study, 45 of the 71 children with significant refractive error, had astigmatism. Similarly, in our study, astigmatism was the most common refractive error.

Simon *et al*. in a study on anisometropic amblyopia and NLDO, has described five children with NLDO and anisometropic amblyopia involving the affected eye.[23] In our study, six children had unilateral CNLDO and anisometropia. All of them had greater hypermetropia on the affected side compared to the fellow eye. Two of these children in this group went on to develop amblyopia requiring glasses and occlusion.

Published data on the prevalence of anisometropia (≥1 D difference between the eyes) in the pediatric population show prevalence ranging from 2.3% to 3.4% (age 5–11 years).[24,25] The prevalence of anisometropia (≥1.50 D) in our study population (0–5 years) was 4.23%.

The possible explanation for the increased prevalence of the relative hypermetropia on the side of CNLDO could be interference with emmetropization. Considering the group of children with the amblyogenic potential was relatively older (mean age - 3.25 years) as compared to the study cohort (mean age - 1.5 years), it is difficult to explain the relative hypermetropia. The alternative probable hypothesis would be an anatomical abnormality of the orbit resulting in failure of canalization either unilateral or bilateral along with a reduced axial length of the globe leading to hypermetropia.[26] Further studies are needed to establish the exact cause and association of relative hypermetropia.

Our data showed the presence of amblyopiagenic risk factors in 20% of our patients; however, when we reanalyzed the data set applying the modified guidelines, there was a significant reduction in the prevalence to 14.78% which is closer to what has been reported in the general population.[18-20] Hence, CNLDO perhaps is not an additional factor increasing the risk of amblyopia as thought earlier. Despite a reduction in the prevalence of factors by reanalyzing the data, there is no denying the fact that children with CNLDO require a comprehensive ophthalmic evaluation and these risk factors would otherwise be missed.

The major limitation of our study was the absence of a control group of age-matched normal children to compare the prevalence of the risk factors. The other limitation of our study was the selection bias, as we included only children who underwent probing. It is possible that we may have missed including some children with amblyopia risk factors in this study who had a resolution of NLDO either spontaneously or with conservative therapy.

Conclusion

Prevalence of amblyogenic risk factors was found to be 20% in this study. Prevalence reduces from 20% to 14.78% on applying modified guidelines, which is comparable to the prevalence reported in the general population. CNLDO does not appear to be an additional independent risk factor for developing amblyopia. Irrespective of the prevalence rate, these children who present with symptoms of CNLDO need a comprehensive ophthalmic evaluation including a cycloplegic refraction and subsequent follow-up to prevent amblyopia.

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Conflicts of interest

There are no conflicts of interest.

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