Objective: To determine whether there is a relationship between congenital nasolacrimal duct obstruction (CNLDO) and subsequent refractive error disorders in children.

Methods: The medical records of children 5 years and younger diagnosed as having CNLDO between January 1, 2000, and December 31, 2007, were retrospectively reviewed.

Results: Three hundred five consecutive children were diagnosed as having CNLDO at a median age of 12.3 months (range, 0.8 months to 4.8 years). Thirty children (9.8%) were diagnosed as having anisometropia with (n=16) or without (n=14) amblyopia at a median age of 19.2 months (range, 3.6 months to 7.4 years). Twenty-six of the 30 patients had hyperopic anisometropia; more severe hyperopia occurred in the eye with CNLDO in 23 patients (88.5%), 2 patients had more severe hyperopia in the fellow eye, and 1 patient had bilateral CNLDO. The median initial (P=.005) and final (P<.001) refractive error was significantly more hyperopic in those with both CNLDO and anisometropia compared with those with CNLDO alone.

Conclusions: The development of anisometropia with or without amblyopia seems to be more frequent in children examined by an ophthalmologist for CNLDO compared with that reported for the general public. The laterality of more severe hyperopia and amblyopia is generally on the side of the previous dacrystenosis.

Arch Ophthalmol. 2010;128(9):1166-1169

Neonatal Dacryostenosis as a Risk Factor for Anisometropia

Joshua T. Piotrowski, BA; Nancy N. Diehl, BS; Brian G. Mohney, MD

ON GENITAL NASOLACRIMAL duct obstruction (CNLDO) has been reported to affect up to 20% of infants1 and is characterized by constant epiphora and intermittent discharge in one or both eyes. Although CNLDO spontaneously resolves for most patients in the first several months of life, the symptoms of some patients may persist for several years.2,3 It is unknown what role, if any, persistent tearing has in the visual development of children. Although there are anecdotal reports linking anisometropic amblyopia to CNLDO, published studies6,7 have been inconclusive regarding this association. The objective of this study was to describe the refractive error findings in a consecutive series of children diagnosed by an ophthalmologist as having CNLDO.

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METHODS

The medical records of all patients diagnosed as having CNLDO at 5 years or younger by an ophthalmologist at Mayo Clinic, Rochester, Minnesota, between January 1, 2000, and December 31, 2007, were retrospectively reviewed. Institutional review board approval was obtained for this study from Mayo Clinic. Patients were identified by retrieving and reviewing medical records with a medical diagnosis of epiphora, dacryostenosis, nasolacrimal duct obstruction, lacrimal duct stenosis, lacrimal obstruction, tear duct obstruction, or tear duct stenosis. A total of 1837 children 3 years or younger were diagnosed as having 1 of these diagnoses during the 8-year study, most of which were made in the first several months of life by the patient’s primary care physician. Of the 1837 patients, 325 (17.5%) were referred to and examined by an ophthalmologist for persistent symptoms. Twenty of the 325 referred patients (6.2%) did not undergo a cycloplegic refraction. The medical records of the remaining 305 patients (16.4%) were retrospectively reviewed to evaluate the presence of refractive error and other ocular abnormalities.

Data on the patient’s gestational age, birth weight, sex, race/ethnicity, and age at diagnosis were reviewed. The ophthalmologic record was reviewed for visual acuity, ocular alignment and motility, refractive error, and anterior and posterior segment findings. The presence or absence of epiphora or discharge and the course of treatment were reviewed for all the patients. A cycloplegic refraction was performed with cyclopentolate, 1%, in most of the study patients. The initial refractive error was recorded during the first ophthalmology appointment for all the patients. The final refractive error was defined as the most recent refractive error obtained from the ophthalmic record. Amblyopia was diagnosed in preverbal children as a consistent objection or displeasure in occluding the better-seeing eye and
in older children as a difference in visual acuity of 2 Snellen lines or more between the 2 eyes. Anisometropia was defined as a difference in the spherical equivalent between the 2 eyes of 1 diopter (D) or greater. Each study patient was observed to his or her most recent examination.

Continuous data are given as medians (ranges), and categorical data are given as counts (percentages). Comparisons between groups for continuous variables were completed using Wilcoxon rank sum tests; comparisons between groups for categorical variables were completed using Fisher exact tests, with the χ² test used for more than 2 groups. All statistical tests were 2-sided, and the threshold of significance was set at α = .05.

### RESULTS

The historical and clinical characteristics of the 305 study patients at the time of diagnosis in the Department of Ophthalmology are given in Table 1. There were nearly equal numbers of boys and girls, and 13.1% of the patients were born prematurely. The median age at diagnosis for the 305 consecutive patients was 12.3 months (range, 0.8-57.7 months). The laterality of symptoms at initial presentation was essentially one-third each for bilateral, right, and left eye involvement. Positive symptoms of CNLDO included epiphora in 91.1% of patients and discharge in 30.8%. The median age at diagnosis for both groups was slightly longer than 12 months. The children who developed anisometropia were markedly more hyperopic at the initial and final examinations compared with those who did not develop anisometropia.

The subsequent refractive and strabismic findings in the 305 patients with CNLDO observed to a mean age of 19.2 months (range, 3.6 months to 7.4 years) are given in Table 2. Anisometropia with and without amblyopia was diagnosed in 16 (5.2%) and 14 (4.6%) patients, respectively. Four of the 30 children with anisometropia had more severe myopia and 26 had more severe hyperopia. Children were diagnosed as having anisometropia that did not progress to amblyopia at a median age of 19.7 months (range, 4.0-87.0 months), and those with anisometropic amblyopia were diagnosed at a median of 18.9 months (range, 6.5-89.4 months). The median difference in refractive error at the time of diagnosis for patients with anisometropic amblyopia was 2 D (range, 1-6.25 D) and for patients with anisometropia alone was 1 D (range, 1-9 D). Nine additional patients (3.0%) were diagnosed as having strabismic amblyopia and 4 (1.3%) as having deprivation amblyopia.

The laterality of the eyes affected with dacrystenosis and anisometropia are given in Table 3. Thirty of 305 patients (9.8%) diagnosed as having CNLDO were found to have anisometropia. Twenty-six of these 30 patients were hyperopic. Twenty-three of 26 hyperopic patients (88.5%) developed more severe hyperopia in the eye associated with dacrystenosis. Two hyperopic patients (7.7%) developed greater refractive error in the fellow eye and 1 (3.8%) with bilateral CNLDO developed bilateral amblyopia with more severe hyperopia in the left eye. Four of the 30 patients with anisometropia were myopic, of which none progressed to anisometropic amblyopia. Two myopic patients had more severe myopia in the eye with CNLDO, and 2 had bilateral CNLDO.

The clinical characteristics of children who developed anisometropia with and without amblyopia and those who did not are given in Table 4. The median age at CNLDO diagnosis for both groups was slightly longer than 12 months. The children who developed anisometropia were markedly more hyperopic at the initial and final examinations compared with those who did not develop anisometropia. No other historical or clinical features were associated with the development of anisometropia.

### COMMENT

The findings from this 8-year consecutive case series of 305 children diagnosed by an ophthalmologist as having CNLDO showed a high prevalence (9.8%) of anisometropia with or without amblyopia. In children with hyperopic anisometropia, almost 90% had a greater refractive error in the eye affected with congenital dacrystenosis, and 14 of 16 patients with anisometropic amblyopia also...
developed amblyopia in the eye with a history of epiphora. There was a statistically significant difference in the refractive errors of patients who developed anisometropia compared with those who did not.

Generally, CNLDO is considered a relatively benign disease with no significantly adverse association with visual development.\(^7\) Although most children with CNLDO experience resolution in the first year of life, approximately 4% of those with dacryostenosis continue to have symptoms persisting beyond 1 year of age.\(^1,3,4,8\) Chalmers and Griffiths\(^6\) reported 5 cases of anisometric amblyopia among 130 cases of CNLDO (3.8%), with more severe hyperopia occurring in the same eye as the epiphora, suggesting that persistent epiphora may disrupt emmetropization. However, Ellis et al\(^7\) reported no significant difference between the prevalence of amblyopia or hyperopic anisometropia in children with CNLDO and a control group without dacryostenosis. However, they reported that amblyopia, when present, was always found in the eye with more severe hyperopia.\(^7\) In this study, 14 of 16 children (87.5%) with hyperopic anisometric amblyopia developed amblyopia in the eye with epiphora. An additional 9 of 10 children (90%) with hyperopic anisometric amblyopia without amblyopia also developed more severe hyperopia ipsilateral to their epiphora. Only 3 of 30 children (10%) who developed some form of hyperopic anisometropia possessed bilateral CNLDO. Most patients with CNLDO who developed anisometropia had unilateral dacryostenosis.

There has been only limited investigation into the association of dacrystenosis and other pediatric visual disorders. The early-in-life focusing of visual images on the retina is vital for proper emmetropization.\(^9\) Postnatal eyelid closure or opacification of the cornea are well-known to cause myopia.\(^10\) However, CNLDO rarely results in total obstruction of the visual field. Distortion of retinal images from persistent tearing in CNLDO may be sufficient to result in ametropia but not myopia. This partial disruption of emmetropization may be the cause of the increased prevalence of hyperopic anisometropia in this study population of patients with congenital dacrystenosis.

Regardless of the exact etiology, a link between specific historical and clinical characteristics and the development of anisometropia was not found in this study. The presence of neither epiphora nor discharge on examination was associated with an increased risk of anisometropia in this study. The duration and severity of epiphora and discharge seem likely to have an association with anisometropia rates. However, owing to the retrospective nature of this study, we could not properly evaluate for these factors. In addition, severe epiphora during a specific age range and stage of emmetropization may increase the risk of anisometropia.

Published studies\(^11-13\) of the prevalence of anisometropia (≥1-D difference between the eyes) in the pediatric population range from 2.3% to 3.4% in children aged 5 to 11 years. In a 2008 study\(^14\) in Newfoundland, Canada, a 1.4% prevalence of anisometropia was reported in chil-

### Table 3. Association Between CNLDO Diagnosis and Refractive Error in Patients With Anisometropia and Anisometric Amblyopia

<table>
<thead>
<tr>
<th>Variable</th>
<th>Greater Refractive Error in Same Eye as CNLDO</th>
<th>Greater Refractive Error in Fellow Eye to CNLDO</th>
<th>Bilateral CNLDO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperopic anisometric amblyopia</td>
<td>14 (87.5)</td>
<td>1 (6.2)</td>
<td>1 (6.2)</td>
<td>16</td>
</tr>
<tr>
<td>Hyperopic anisometropia only</td>
<td>9 (90.0)</td>
<td>1 (10.0)</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Myopic anisometric amblyopia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Myopic anisometropia only</td>
<td>2 (50.0)</td>
<td>0</td>
<td>2 (50.0)</td>
<td>4</td>
</tr>
<tr>
<td>All Cases of Anisometropia</td>
<td>25 (83.3)</td>
<td>2 (6.7)</td>
<td>3 (10.0)</td>
<td>30</td>
</tr>
</tbody>
</table>

Abbreviation: CNLDO, congenital nasolacrimal duct obstruction. 
\(^a\) Due to rounding percentages may not total 100.

### Table 4. Comparisons Between Children With CNLDO Who Developed Anisometropia and Those Who Did Not

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>With Anisometropia (n=30)</th>
<th>Without Anisometropia (n=275)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex, No. (%)</td>
<td>12 (40.0)</td>
<td>133 (48.4)</td>
<td>.44</td>
</tr>
<tr>
<td>Patients born prematurely, No. (%)</td>
<td>4 (13.3)</td>
<td>36 (13.1)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Birth weight &gt;0-1000 g, No. (%)</td>
<td>1 (4.2)(^a)</td>
<td>3 (1.5)(^b)</td>
<td>-.86</td>
</tr>
<tr>
<td>Birth weight &gt;1000-3000 g, No. (%)</td>
<td>5 (20.8)(^a)</td>
<td>49 (24.4)(^b)</td>
<td>.64</td>
</tr>
<tr>
<td>Birth weight &gt;3000 g, No. (%)</td>
<td>18 (75.0)(^a)</td>
<td>149 (74.1)(^b)</td>
<td>.14</td>
</tr>
<tr>
<td>Age at CNLDO diagnosis, median, mo</td>
<td>12.48</td>
<td>12.25</td>
<td>.25</td>
</tr>
<tr>
<td>Patients with epiphora on presentation, No. (%)</td>
<td>30 (100)</td>
<td>248 (90.2)</td>
<td>.005</td>
</tr>
<tr>
<td>Patients with discharge on presentation, No. (%)</td>
<td>14 (46.7)</td>
<td>157 (57.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Initial refractive error, median (SE)</td>
<td>2.44</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Final refractive error, median (SE)</td>
<td>2.75</td>
<td>1.5</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: CNLDO, congenital nasolacrimal duct obstruction; SE, spherical equivalent.

\(^a\) Based on a denominator of 24.

\(^b\) Based on a denominator of 201.
children (mean age, 4.2 years), and in a recent study from Sydney, Australia, the pediatric (mean age, 6.7 years) prevalence of anisometropia was 1.6% to 2.4%. Although population-based studies have reported anisometropia rates of 7.2% to 9.3%, the populations surveyed were older children (7-18 years) or adults. In this cohort, 26 children (8.5%) with CNLDO developed hyperopic anisometropia and 4 (1.3%) developed myopic anisometropia for a total anisometropia prevalence of 9.8%. These results suggest that there may be a greater prevalence of anisometropia in children with chronic dacyrostenosis.

In addition to a possible increased risk of anisometropia, the prevalence of amblyopia may also be elevated in children with CNLDO. Amblyopia has been reported to occur in 1.3% to 2.5% of preschool children in the United Kingdom and in 1.8% of elementary school children in Berkeley, California. Because strabismic amblyopia and anisometropic amblyopia have been reported to compose approximately equal shares of amblyopia prevalence in the general populace, the calculated rates for anisometropic amblyopia alone would range from 0.65% to 1.25%. Sixteen children in this study (5.2%) were diagnosed as having anisometropic amblyopia, with 14 of the 16 developing amblyopia in the eye affected by CNLDO. If the children with strabismic and deprivation amblyopia observed in this study were included, the combined prevalence of amblyopia would increase to 29 children (9.5%), a rate that is substantially higher than that reported for the general population.

There are several limitations to the findings in this study. The retrospective design is limited by nonstandardized and incomplete data collection. Furthermore, because of the necessity of obtaining refractive error data, only the medical records of children examined by an ophthalmologist for dacryostenosis symptoms were reviewed, creating a potential for selection bias. Patients referred to an ophthalmologist are likely to have more severe or persistent epiphora or other ocular abnormalities noted by the primary care physician. Likewise, parents of children with suspected visual abnormalities may be more likely to seek referral care than those with mild or intermittent tearing. In addition, because the mean age at the initial ophthalmologic evaluation occurred at 12.3 months, we could not determine whether early spontaneous resolution of epiphora is associated with a corresponding resolution of anisometropia. However, the study findings remain instructive because the study population is representative of those who seek ophthalmic care.

This study reports a 9.8% prevalence rate of anisometropia in young children diagnosed by an ophthalmologist as having CNLDO, a rate that is higher than that reported for the general population. Of the 26 children (8.5%) with hyperopic anisometropia, all but 2 developed more severe hyperopia in the eye with persistent epiphora, and 1 child was diagnosed as having bilateral CNLDO. These findings suggest a possible association between persistent CNLDO and an increased risk of anisometropia, primarily with more severe hyperopia in the eye with chronic epiphora. Infants and young children with symptoms of dacyrostenosis should routinely undergo a dilated funduscopic examination and cycloplegic refraction to rule out the presence of anisometropia, early-onset glaucoma, and other ocular abnormalities.

Submitted for Publication: December 11, 2009; final revision received January 24, 2010; accepted February 1, 2010.

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Financial Disclosure: None reported.

Funding/Support: This study was supported in part by an unrestricted grant from Research to Prevent Blindness Inc.

Role of the Sponsor: Research to Prevent Blindness Inc had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.

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