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RESEARCH ARTICLE

Evaluation of factors causing congenital nasolacrimal duct obstruction and their effects on probing success

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ABSTRACT

Aim: To determine the etiological and demographic characteristics of congenital nasolacrimal duct obstruction (CNLDO) and to evaluate the effectiveness of probing.

Methods: The study included 33 children who applied to the clinic with epiphora, were diagnosed with CNLDO and underwent probing, and 27 healthy children. Age, gender, probing time, recurrence, accompanying anomalies, and hemogram values were recorded from their records, neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), monocyte-lymphocyte ratio (MLR) and systemic immune-inflammation index (SII) were calculated. The term "successful probing" refers to achieving complete resolution of all signs and symptoms of epiphora 1 year after treatment.

Results: The mean age at the time of surgery of 33 patients who underwent probing (16 F, 17 M) was 18.42±7.85 months, while the mean age of the 27 controls (10 F, 17 M) was 22.30± 9.98 months (p=0.108). Platelet levels were significantly lower (p=0.014) and monocyte levels were significantly higher (p=0.012) in the CNLDO group. While there were no significant differences in SII, NLR, and PLR values, the MLR value was significantly higher in the CNLDO group (p=0.026). Recurrence was detected in four patients (12.2%). In the CNLDO group, three patients had undescended testicles, one patient had an inguinal hernia, and one patient had a cleft palate. No significant difference was found between probing time and systemic inflammatory markers and recurrence (for all values p> 0.05).

Conclusion: Platelet, monocyte levels, and MLR ratio were closely associated with CNLDO. Additional anomalies may accompany CNLDO. Successful results can be obtained with probing in the following months.

Keywords: congenital nasolacrimal duct obstruction, epiphora, probing, systemic immune-inflammation index

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INTRODUCTION

Approximately 6%-20% of newborns suffer from congenital nasolacrimal duct obstruction (CNLDO) (1-4). There is a persistent blockage in the nasolacrimal duct (NLD) due to a delay in maturation at the valve of Hasner, where the lacrimal duct opens into the inferior nasal meatus (2,4-7). Typically, infants with CNLDO present within the first month of life with symptoms such as epiphora, mucous discharge, recurrent periocular crusting, or a combination of these (2,5,8,9). CNLDO is typically an isolated condition. However, it may occur more frequently in children with craniofacial anomalies or Down syndrome, and the most common disease pattern in these children is bilateral obstruction (2,10). The condition usually affects one eye, but it can also affect both eyes (2). Confirmation was made through the fluorescein dye disappearance test (FDT) (5).

The majority of cases of CNLDO resolve spontaneously or with conservative methods, such as lacrimal sac massage (Crigler's maneuver) during the first year of life (1,6,10-13). If CNLDO continues to be a problem, the preferred treatment is lacrimal probing (1,4,6,10,13-16). Success rates for resolving obstructions may vary based on factors such as disease severity, cause, patient age, overall health, and history of surgery.

According to the literature, the success rate of lacrimal probing decreases as the child's age increases (1,4,17,18). Cesarean section can increase the likelihood of experiencing CNLDO (19-21).

The precise cause and predisposing factors for CNLDO are currently unknown. It has been reported that chronic inflammation in the nasolacrimal duct (NLD), nasal cavity, and sinuses can cause primary acquired nasolacrimal duct obstruction (PANDO) (22,23). Various markers such as systemic immune-inflammation index (SII), neutrophil-to-lymphocyte ratio (NLR), monocytes-to-lymphocyte ratio (MLR), and platelet-to-lymphocyte ratio (PLR) can be utilized to identify inflammation, predict prognosis, and monitor the disease (18,24,25).

This can help to identify the underlying anatomical and inflammatory factors that contribute to obstruction, guide the selection of the most appropriate surgical technique, and improve surgical outcomes.

The purpose of the study is to identify the inflammatory markers that are associated with CNLDO and to present the factors that affect the success of probing.

MATERIALS AND METHODS

This retrospective study was conducted at the Department of Ophthalmology in Fatih Sultan Mehmet Training and Research Hospital. The study was approved by the Ethics Committee (FSMEAH-KAEK 2023/100). The study was conducted according to the guidelines of the Declaration of Helsinki. Informed consent was obtained from the participants and was archived by the authors.

Clinical data of the patients who underwent probing for CNLDO between January 2015 and December 2022 were analyzed. The exclusion criteria included being older than 5 years, having previous sinus, nose, turbinate or lacrimal surgery, nasopharyngeal malignancy, prior history of maxillofacial fracture and NLD trauma, pathology of the lacrimal canaliculi, reflex hypersecretion, and systemic diseases such as cardiovascular diseases, acute/chronic kidney, diabetes, rheumatic disease.

In the study, 33 children with CNLDO were in the case group (CNLDO), while 27 healthy children were in the control group. Age, gender, probing time, recurrence status, and accompanying anomalies were recorded from the registered electronic files of the patients. The patient's ocular examination involved eliminating the possibility of local reasons for tearing, such as foreign body, conjunctivitis, blepharitis, or buphthalmos. The FDT confirmed the diagnosis of CNLDO. FDT was performed by instilling one drop of 2% fluorescein solution into the conjunctival fornix without anesthesia. After 5 minutes, each eye was examined for proper clearance using the cobalt blue filter light of the slit lamp.

Procedures were performed under general anesthesia. The lower punctum underwent dilation using a punctum dilator of appropriate size. A straight Bowman probe was then inserted vertically in the

lower punctum, progressed into the ampulla, and rotated horizontally into the lower canaliculus while exerting lateral tension on the eyelid. The probe was rotated 90 degrees and advanced downward and slightly backward through the NLD when encountering a hard stop. The valve of Hasner was felt to open.

After the probing procedure, the patient received topical drops containing both an antibiotic and a corticosteroid for several days. FDT was repeated one year after probing. The probing was considered "successful" when there were no symptoms of epiphora and no fluorescence in the conjunctival sac after FDT.

According to the results of blood analysis, serum white blood cell (WBC), neutrophil, lymphocyte, monocytes, and platelet (P) values were recorded; SII, NLR, MLR, and PLR were calculated in both the case and control groups. The SII was calculated from the preoperative counts of peripheral blood P, neutrophils (N), and lymphocytes (L) per liter according to the equation (SII = P x N/L) (26).

Statistical analysis

In the descriptive statistics of the data, mean, median minimum and maximum, standard deviation, and frequency were used. The Kolmogorov-Smirnov test was used to measure the distribution of variables. Independent sample t-test and Mann-Whitney U test were used in the analysis of quantitative independent data. The Chi-square test was used in the analysis of qualitative independent data, and the Fischer test was used when the conditions for the Chi-square test were not met. SPSS 28.0 program was used in the analysis.

RESULTS

Our study consisted of 33 patients (17 male, 16 female) who underwent probing and 27 (17 male, 10 female) healthy controls. The mean age was 18.42±7.85 months in the study group and 22.30±9.98 months in the control group. There was no significant difference in the age and gender ratio between the groups (p=0.108 and p=0.469, respectively). The descriptive characteristics of the patients are presented in Table 1.

Table 1. Descriptive characteristics of the patients in the congenital nasolacrimal duct obstruction and control groups

		Control Group			Case Group			p
		Mean±SD/n-%			Mean±SD/n-%			
Age (months)		22.30	±	9.98	18.42	±	7.85	0.108 [t]
Gender	Female	10		37%	16		48.4%	0.469 [X²]
	Male	17		62.9%	17		51.5%	
WBC 10^9/L		9.8	±	2.2	9.8	±	2.5	0.744 [m]
Platelet 10^9/L		399.0	±	81.9	341.3	±	83.8	**0.014** [t]
Lymphocyte 10^9/L		5.66	±	1.83	5.17	±	1.5	0.552 [t]
Monocyte 10^9/L		0.65	±	0.23	0.83	±	0.28	**0.012** [m]
Neutrophil 10^9/L		3.11	±	1.39	3.45	±	2.02	0.749 [m]
PLR		77.14	±	27.93	73.62	±	36.9	0.369 [m]
MLR		0.12	±	0.06	0.18	±	0.10	**0.026** [m]
NLR		0.61	±	0.37	0.82	±	0.94	0.688 [m]
SII		247.34	±	156.71	283.40	±	363.12	0.508 [m]

[t] Independent sample t-test; [m] Mann-whitney u test / [X²] Chi square test

WBC: White blood cell; PLR: platelet-to-lymphocyte ratio; MLR: monocytes-to-lymphocyte ratio; NLR: neutrophil-to-lymphocyte ratio; SII: systemic Immune-inflammation index.

Table 2. Descriptive characteristics of the patients according to the presence of recurrence

	Recurrence (-)			Recurrence (+)			p
	Mean±SD/n-%			Mean±SD/n-%			
WBC 10^9/L	7.2	±	1.8	6.6	±	1.9	0.826 [t]
Platelet 10^9/L	342.2	±	15.8	320	±	50.8	0.699 [t]
Lymphocyte 10^9/L	5.24	±	0.28	5.52	±	0.69	0.730 [t]
Monocyte 10^9/L	0.84	±	0.5	0.83	±	0.16	1.000 [m]
Neutrophil 10^9/L	3.35	±	0.35	2.78	±	0.45	0.721 [m]
PLR	70.04	±	4.6	58.5	±	7.47	0.361 [m]
MLR	0.18	±	0.02	0.15	±	0.02	0.934 [m]
NLR	0.70	±	0.1	0.52	±	0.11	0.763 [m]
SII	236.91	±	32.11	223.86	±	24.10	0.640 [m]
PT (months)	17.5	±	1.40	24.86	±	4.31	0.186 [t]

[t] Independent sample t-test; [m] Mann-whitney u test

WBC: White blood cell; PLR: platelet-to-lymphocyte ratio; MLR: monocytes-to-lymphocyte ratio; NLR: neutrophil-to-lymphocyte ratio; SII: systemic Immune-inflammation index; PT: probing time.

Probing was performed on the right eye of seven patients, the left eye of 15 patients, and both eyes of 11 patients. Platelet values were significantly lower (p=0.014) and monocyte levels were significantly higher (p=0.012) in the CNLDO group. While there was no difference in SII, NLR, and PLR values between the groups, the MLR value was significantly higher in the CNLDO group (p=0.026). Recurrence was detected in four patients (12.2%). No significant difference was found in probing time between recurring and non-recurring CNLDO patients (p=0.186). No significant difference was found in terms of systemic inflammatory markers based on recurrence status (for all values p> 0.05) (Table 2). Undescended testis was found in three patients, an inguinal hernia in one patient, and a cleft palate in one patient in the CNLDO group.

DISCUSSION

We studied the blood samples of patients diagnosed with CNLDO and undergoing probing for CNLDO and compared them with the healthy control group in terms of the nasolacrimal system.

CNLDO is frequently observed in children, which affects their lacrimal system (8). The valve of Hasner membrane opens spontaneously or with Crigler's maneuver in up to 90% of affected children by one year of age. Natarajan et al. reported that CNLDO is more frequently found in male preterm infants with normal birth weight and is typically unilateral (2). It is reported that CNLDO is often related to coexisting ocular or systemic anomalies, such as Down syndrome (2,17). The majority of children in our study had unilateral CNLDO, with a 33% rate of bilaterality. In the CNLDO group, three patients had undescended testis, one inguinal hernia, and one patient had cleft palate, all of which were unilateral.

The timing of probing in children with CNLDO is controversial (4,5). Świerczyńska et al. suggested probing at 7-9 months for children without recurring infections, while early probing may be considered for children with additional signs (10).

Lekskul et al. reported that the effect of Crigler's maneuver decreased in the following months, but the effect persisted with the probing procedure (4). Lee et al. demonstrated that the timing of probing does not impact the success of treatment in patients with bilateral CNLDO (27). Arora et al. found that children probed before age three had higher success rates than those probed after age three (13). We found no significant relationship between probing time and its success.

Al-Faky et al. reported that silicone intubation may be required in complex and bilateral cases while probing is sufficient for children with CNLDO over one-year-old (16,28). In our study, we attempted to probe all patients initially. In cases where probing was unsuccessful, silicone intubation was performed on children.

We used the appropriate straight Bowman probe in all the children we probed. However, Serin et al. found higher success rates with manually curved Bowman probes compared to straight ones (6).

Many factors are indicated for the obstruction of the valve of Hasner, such as fibrosis and inflammation (7). A study suggested a potential link between infection and CNLDO, but findings indicate that there is no significant difference in microbial growth rates between those with and without CNLDO. Moreover, the spontaneous resolution rate appears to be consistent regardless of the presence of pathogenic bacteria (7,29).

Wang et al. found that patients with NLD obstruction had higher levels of pro-inflammatory cytokines in their tears compared to the control group (30).

Matsumura et al. found that IL-6 concentration was significantly higher in eyes with CNLDO compared to control eyes (31).

In many studies, the authors suggested that probing in the following months will reduce the chance of success due to increased inflammation and fibrosis in the NLD (32,33).

We examined the hemogram values of CNLDO patients to determine inflammation markers that cause and affect the prognosis of CNLDO.

We found SII to be a newly suggested predictive inflammatory biomarker in various systemic inflammatory disorders (34). Also, it has been shown that mean platelet volume (MPV) can serve as a new inflammation indicator, with significant decreases observed in conditions such as lung cancer, ankylosing spondylitis, and rheumatoid arthritis (35,36). Atum et al. discovered significantly higher NLR values and significantly lower MPV values in the PANDO group (26).

We observed no significant difference in NLR, PLR, and SII values between the groups. However, monocyte and MLR values, which are indicators of systemic inflammation, were higher in the CNLDO group, while the platelet value was lower. Nevertheless, we could not establish a relationship between systemic inflammatory markers and recurrence.

Monocytes play an essential role in inflammation and can independently predict cardiovascular events (37). We hypothesize that there may be a correlation between monocyte levels and CNLDO.

The study has limitations such as its retrospective nature, small sample size, and lack of biopsy examinations. Future studies with a larger number of recurrent cases and biopsy examinations can better explain the relationship between systemic inflammatory biomarkers and probing recurrence.

This is the first study to assess the relationship between probing in CNLDO patients and inflammatory biomarkers. Monocyte and MLR levels were significantly higher, and platelet values were significantly lower in CNLDO patients compared to healthy controls.

Monocyte and MLR can be used as simple, inexpensive, and reliable indicators to predict the cause and outcome of CNLDO in patients. We have demonstrated that CNLDO patients can achieve successful results with probing in children in later months. Further studies may reveal the link between probing success and systemic inflammation in CNLDO.

Ethical approval

This study has been approved by the Fatih Sultan Mehmet Training and Research Hospital Ethics Committee (approval date 14/09/2023, number 2023/100). Written informed consent was obtained from the participants.

Author contribution

Concept: NS; Design: NS; Data Collection or Processing: MÇ; Analysis or Interpretation: SAK; Literature Search: NS; Writing: NS. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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