

Tear Osmolarity Changes Following External and Trans-Canalicular Dacryocystorhinostomy in Primary Acquired Nasolacrimal Duct Obstruction

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Abstract

Purpose: The aim of this study is to evaluate the tear osmolarity(TO) in patients with epiphora caused by primary acquired nasolacrimal-duct obstructions(PANDOs), before and one month after an external dacryocystorhinostomy(E-DCR) and trans-canalicular laser-assisted endoscopic dacryocystorhinostomy(TLA-DCR).

Material-Methods: Twenty eyes of 21 patients(16 women, 5 men) who suffered from epiphora and, 20 healthy eyes of the same subjects were included in this study. External(Group 1) or laser-assisted(Group 2) DCR were applied to all patients with PANDO.

Results: The mean age of the subjects was 60.09 ± 8.46 in Group 1, 57.50 ± 9.41 in Group 2 and, 55.13 ± 9.38 in healthy control subjects. The mean period for complaints of epiphora was 1.9 ± 0.7 years. Nasolacrimal duct irrigation was successful in all patients at the first-month visit after surgery. Group 1 had a mean TO of 284.16 ± 12.43 mOsm/l and, Group 2 had 286.70 ± 10.46 mOsm/l before DCR, and this increased to 295.75 ± 5.86 mOsm/l and, 298.70 ± 8.76 mOsm/l one month after DCR, respectively. Preoperative TO values in both groups were significant hypoosmolar compared with the control group (292.27 ± 9.65 mOsm/l). No significant differences were detected between postoperative and control group TO values.

Conclusion: We found no significant osmolarity changes between surgery and control groups.

Introduction

Tear osmolarity (TO) depends on a variety of complex interactive processes associated with tear secretion, evaporation, and drainage.^{1,2,3}

These can include the effects of the region of the ocular surface exposed to the air, the inflammation of the eye about to with concerning the chemical condition of the environment, including inflammatory mediators, the TO, and the gaseous environment, the amount of tears that are produced, the state of the ocular surface, the efficacy of the lacrimal drainage apparatus, the quality of the tear lipid layer, the position of the upper and lower eyelids and, the blink mechanism.^{4,5}

Although many research studies have continued to study the relationship between dry-eye disease and TO, few researchers evaluated TO in patients with epiphora and found different results.^{6,7,8} Like hyperosmolarity, hypoosmolarity causes osmotic cell stress. It is therefore likely that changes to normal osmolarity values are beneficial to the health and function of ocular surface cells.^{9,10}

In this regard, the present study aimed to evaluate TO in patients with epiphora caused by primary acquired nasolacrimal-duct obstructions (PANDOs), before and one month after an external dacryocystorhinostomy (E-DCR) and trans-canalicular laser-assisted endoscopic dacryocystorhinostomy (TLA-DCR) to compare these patients' results with healthy control subjects.

Material- Method

This study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Bagcilar Training and Research Hospital Clinical Research Ethics Committee. Written informed consent was obtained from the patients following a detailed explanation of the study objectives and protocol. Twenty eyes of 22 eyes of 21 patients (16 women, 5 men) who suffered from epiphora for at least one year due to PANDO, and 20 healthy eyes of the control group with no ocular complaint and ocular disease were included in this study. External (Group 1) or laser-assisted (Group 2) DCR were applied to all patients with PANDO by the same surgeon team (ŞAN, AY), and patients were treated with topical antibiotics and steroids for 10 days following the surgery. Tear osmolarity measurements were repeated at the first-month follow-up visit after surgery. Re-establishment of nasolacrimal drainage confirmed by irrigation after TO measurements. Age, gender, laterality, medical and ocular history, and time of epiphora complaints were recorded. Patients with systemic diseases, with histories of dry-eye disease, ocular surface disease, thyroid eye disease, previous ocular surgery, current or recent topical treatment, and active or chronic ocular infections or allergies were excluded.

The TearLab Osmolarity System (TearLab Corp., San Diego, CA) was used for the tear osmolarity assessment. It is an in situ osmometer that measures the osmolarity of a sample of 50 nanoliters in 5 seconds, with the units expressed in milliosmols per liter (mOsm/L). It consists of a system reader that calculates and displays the results of the osmolarity test, single-use osmolarity test cards that facilitate the collection of tear samples, and two system pens that are designed to hold the test cards. The method of measurement is based on the principles of electrical impedance of the tear solution.⁵ While the normal value is ≤ 308 mOsm/L, above 308 mOsm/L has been defined as abnormal. In this study, we accepted the TO value as 269 mosm/l when the machine displayed an “error-low” message.

All tests were completed in the morning hours between 9:00 a.m. and 12:00 a.m without the aid of topical anesthesia with room temperature ranging between 22.9–23.8°Celsius.¹¹

Results

The mean age of the subjects was 60.09 ± 8.46 (range:49–71) in Group 1, 57.50 ± 9.41 (range:43–70) in Group 2 and, 55.13 ± 9.38 (range:41–66) in healthy control subjects. There were no statistically significant differences in terms of mean age and gender between each group ($p_1=0.705$, $p_2=0.617$). The mean period for complaints of epiphora was 1.9 ± 0.7 years (1–4). Nasolacrimal duct irrigation was successful in all patients at the first-month visit after surgery. Group 1 had a mean TO of 284.16 ± 12.43 mOsm/l (range: 279–301) and Group 2 had 286.70 ± 10.46 mOsm/l (range: 280–307) before DCR, and this increased to 295.75 ± 5.86 mOsm/l (range:286–303) and 298.70 ± 8.76 mOsm/l (range:285-310) one month after DCR, respectively. ($p_1=0.002$, $p_2=0.001$). Preoperative TO values in both groups were significant hypoosmolar compared with the control group (292.27 ± 9.65 mOsm/l) (range:282–306) ($p=0.004$). No significant differences were detected between postoperative and control group TO values (Table-1).

Table-1

Pre- and postoperative Tear Osmolarity(mOsm/L) values in all groups

	Preoperative	Postoperative	<i>p</i>
E-DCR	284.16±12.43	295.75±5.86	0.002
TLA-DCR	286.70±10.46	298.70±8.76	0.001
Control Group	292.27±9.65		
<i>p</i>	0.004	0.297	

mOsm/L: milliosmols per liter, E-DCR: External dacryocystorhinostomy, TLA-DCR: trans-canalicular laser-assisted endoscopic dacryocystorhinostomy

Discussion

The number of studies on this subject is limited in the literature. Stahl et al compared TO and tear meniscus height in patients with functional nasolacrimal duct obstruction (FNLDO) or primary acquired nasolacrimal duct obstruction (PANDO). They found no differences between groups in preoperative mean TO values (309.4 ± 18.8 , 315.0 ± 23.7 mOsm/ml, respectively); however, tear meniscus height (TMH) was higher in both nasolacrimal duct obstruction groups compared with normal control subjects.

Dacryocystorhinostomy reduced TO not significantly in either group, but it significantly reduced TMH.¹

Yuksel et al.², and Saleh et al.³ evaluated TO in patients with epiphora caused by different etiologies and determined that such patients had lower levels of TO than their control group. And in Yuksel et al.'s study TO values reached normal levels after their epiphora had been resolved through surgical treatment.² In the present study has found similar results.

Tomlinson and associates examined 14 normal subjects who underwent punctal plugging and suggested that this maneuver increases TO slightly, but not significantly and that TO returns to a normal level after plug removal.³

Tear osmolarity measurements have been suggested as a diagnostic procedure for dry-eye disease for several years. Tear hyperosmolarity in dry eyes is well known to cause ocular-surface inflammation.¹² Hyperosmolarity causes cells to shrink by extracting water from the cells.¹³ Like hyperosmolarity, hypoosmolarity is known to cause cell dysfunction. Cell swelling occurs and activates cell-volume regulatory mechanisms such as ion channel activation and gap-junctional conductance decreasing.^{14,15} Hypoosmolarity and hyperosmolarity have been shown to induce osmotic stress on cells and the subsequent release of proinflammatory cytokines in various cell-type cultures.¹⁶ This might be important in maintaining the surface tension and stability of tear films. Under hypoosmolar conditions, decreased

electrolyte levels negatively affect both the surface tension and stability of tear films. This may be another negative aspect of hypoosmolarity on the ocular surface.¹⁸

Conclusion

The present study's results show that the patients with epiphora due to PANDO had lower TO values than the healthy control subjects. After 2 types of surgery, the TO values were increased significantly.

In the light of these findings, we suggest that, with surgery, we do not only treat complaints of epiphora, we may also provide a normal homeostatic balance in tear to protect ocular surface cells. Further studies should be planned to evaluate ocular surface cell health in the case of epiphora.

Declarations

DECLARATION OF INTEREST

No potential conflicts of interest relevant to this article exist.

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