Lacrical Sac Dacryoliths-Pathogenesis and Composition

Lakrimal Kese Dakriolitleri-Patogenez ve Bileşim

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Summary

The main objective of the present study is to review the literature about the chemical composition and the formation of dacryoliths. Dacryoliths are calculi of the lacrimal system observed incidentally during dacryocystorhinostomy. Theories about the formation of dacryoliths mostly suppose that dacryoliths are simply a secondary phenomenon resulting from a lacrimal pathway obstruction and accumulation of debris. Inflammation caused by fungi, most commonly Candida albicans, an eyelash within the sac, or adrenaline use are also considered to be potential causes. It was also reported that the unstable concentrations of electrolytes rather than the supersaturation of some electrolytes are related to the pathogenesis of dacryoliths. Chemical analysis of the dacryoliths in studies had revealed calcium, magnesium, potassium, sulfur, and some phosphorus. Atomic absorption spectrophotometric investigations demonstrated organic proteins and, to a much lesser extent, inorganic material. (Turk J Ophthalmol 2013; 43: 186-9)

Key Words: Dacriolith, dacryocystorhinostomy, atomic absorption spectrophotometry

Özet


Anahtar Kelimeler: Dakriolit, dakriosistorinostomi, atomik absorbsiyon spektrofotometri

Introduction

Dacryoliths were initially described by Cesoni in 1670. They are calculi of the nasolacrimal system which are generally observed incidentally in dacryocystorhinostomy (DCR) operations. Dacryolith formation was reported to occur in between 6 and 18% of patients with nasolacrimal duct obstruction who undergo DCR.

A swelling in the medial canthal region, intermittent or constant epiphora, mucoid discharge, acute lacrimal sac distention, partial obstruction, recurrent acute dacryocystitis can accompany the clinical condition. Interestingly, dacryoliths occur more often in patients with epiphora despite patent lacrimal passages on syringing.

Even though the studies about dacryoliths initiated in very early years, their pathogenesis and composition are still in mystery. Some predisposing factors listed in the literature are female sex, patient age below 50 years, cigarette smoking, facial-sinonasal trauma, and previous attacks of dacryocystitis.
However, some contradictory studies reported increased frequency in males and patients aged above 50 years. But a recent study showed a male:female ratio of 11:9, suggesting that both sexes are involved in a comparable manner. Some studies supporting the idea of female predominance in dacryolithiasis speculate that the obstruction is caused by gender-specific hormonal or anatomic differences.

**Pathogenesis**

No accepted theory exists about the formation of dacryoliths, but some authors suppose dacryoliths are simply a secondary phenomenon, resulting from a lacrimal pathway obstruction and accumulation of debris. Inflammation caused by fungi, most commonly Candida albicans, an eyelash within the sac, or adrenalin use are also considered to be potential causes. In some studies, stones revealed hyphae-like structures although no fungi are recovered by culturing.

Dacryoliths are known to be more common in primary acquired nasolacrimal duct obstruction (PANDO), and PANDO may be related to the early stages of dacryolith formation. In PANDO, descending inflammation from the eye or ascending inflammation from the nose leads to fibrous remodeling of the helical arrangement of connective tissue fibers, loss of specialized blood vessels in the subepithelial cavernous body, and epithelial metaplasia of the mucous membrane in a circumscribed area, which may play a role in dacryolith formation.

A recent study investigated whether there is a relation of dacryolith formation in patients with nasolacrimal duct obstruction with tear constituents and demonstrated a decreased $K^+$ concentration in tears of PANDO patients with dacryoliths. Since tear $K^+$ concentration is known to be very important for corneal surface stability particularly light scattering and healthy epithelial cells, general discomfort such as glare and blurring may be explained as the result of PANDO/dacryoliths. Total calcium concentration in tear was found to be in normal limits in PANDO patients with dacryoliths, even the existing histological examination revealed keratin antibodies; calcium, sulfur and some phosphorus were determined as major constituents in the chemical analysis.

In another study that analyzed the composition of dacryoliths, Herzig et al. examined tear samples obtained from patients with dacryoliths and compared them with seven normal patients with regard to calcium, phosphorus, and uric acid concentrations, tear to serum calcium ratios, and calcium-phosphate products. There was no significant difference between the two groups and thus there was no evidence of formation of dacryoliths due to abnormal tear electrolytes. One dacryolith was examined and shown to be consisting of ammonium and was related to the presence of bacteria in the media. The authors believed that dacryolith formation results from chronic obstruction and inflammation of the sac causing a build-up of various electrolytes, particularly calcium.

A standard classification of dacryoliths according to the composition is not determined up to now since it is not clear what kinds of dacryoliths exist in terms of chemical/histopathological composition. Some may be composed of amorphous inorganic material only and another far more frequent type composed of organic material with secretory product inclusions of epithelial cells, extruded cells and defense cells.

In a recent study by Perry LJ, two major forms of concretions were determined histopathologically: mucoprotein and bacterial. Mucoprotein concretions were found exclusively within the lacrimal sac, while bacterial concretions were found mainly in the canaliculus. A third category of "mixed" concretions with mucoprotein and bacterial characteristics was also defined in some specimen. Bacterial concretions consisted of large masses of filamentous, presumed Actinomyces organisms that were identified with the Grocott's methenamine silver stain. Mucoprotein concretions were generally devoid of cellular elements and were composed diffusely eosinophilic, acellular, periodic acid-Schiff-positive material. They were often colonized by small numbers of bacterial cocci and occasional fungi. All 3 types of concretions were found to predominate in women. Patients with bacterial concretions were reported to have dry eye symptoms frequently.

In recent years, investigators started to use atomic absorption spectrophotometry (AAS) for detection of organic-inorganic compounds in dacryoliths. Iliadelis et al demonstrated dacryoliths consisting almost entirely of organic proteins and, to a much lesser extent, of inorganic material. AAS was used in another study, but this time, no inorganic compound was found in the structure, despite four types of unidentified organic materials in composition, and calcium staining was negative. Polarized X-ray fluorescence spectrometry (XRF) is now determined as an alternative method for the analysis of inorganic elements in dacryoliths. XRF analysis in the case report presenting this new method to the literature demonstrated calcium,
potassium, iron, titanium, manganese, and their oxidized forms (CaO, K₂O, Fe₂O₃, TiO₂, MnO) in the chemical composition of a dacryolith.

Another study about the organic composition of dacryoliths revealed parts of amorphous core proteins staining with alcian blue and reacting with antibodies to mucins and TFF peptides. Moreover, the findings show that most dacryoliths contain single cells and cellular debris. But it is not clear yet whether TFF peptides and mucins influence dacryolith formation or whether their secretion is only a secondary phenomenon. It is also unknown whether dacryolith formation occurs as a reaction to previous inflammation of the nasolacrimal duct or whether other factors such as drugs (perhaps some eye drops), changes in the hormonal status or immunomodulation (allergy) may lead to the initiation of dacryolith formation with recurrent dacryocystitis as a secondary phenomenon.

Differences in the composition of dacryoliths with regard to mucins and defense cells may be explained by colonization with distinct bacteria. Any type of specific bacterial growth is not determined in dacryoliths but fungal colonization (Candida, Pityrosporum spp. and Aeromonas Hydrophila) seems to occur in some cases. Further investigations about the organic and inorganic compounds of dacryoliths and the correlation of dacryolith chemicals to tear film minerals may lead to clarification of the pathogenesis of dacryoliths and to improve the treatments for nasolacrimal obstruction.

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References


Özer et al., Dacroliths-Review of Literature