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Adjunctive hyperbaric oxygen therapy for actinomycotic lacrimal canaliculitis

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A 62-year-old woman suffered for 3 years from persistent epiphora, intermittent mucopurulent discharge, and a localized tumorlike swelling in her right lower lid. Clinical and bacteriologic examination revealed lacrimal canaliculitis caused by *Actinomyces israelii*. The patient was unresponsive to the conventional surgical evacuation of the canaliculus combined with penicillin treatment. Complete cure was achieved only after hyperbaric oxygen therapy was added. The obligate anaerobic bacterium *A. israelii* is extremely sensitive to toxic oxygen radicals produced during hyperbaric oxygen therapy. Thus, adjunctive hyperbaric oxygen may be effective in the treatment of selected cases of refractory actinomycotic lacrimal canaliculitis. The obligate anaerobic bacterium *A. israelii* is the most common cause of chronic lacrimal canaliculitis [2]. Surgical evacuation of the canaliculus, followed by repeated irrigation with penicillin, is usually effective; however, some cases may be unresponsive to this treatment [3, 8]. We present a patient with chronic actinomycotic lacrimal canaliculitis, refractory to the conventional treatment, who was cured only after hyperbaric oxygen therapy was added. A 62-year-old woman was referred to the outpatient ophthalmology clinic at Rambam Medical center for surgical excision of a tumor on her eyelid. The patient had complained of persistent epiphora and intermittent mucopurulent discharge over the preceding 3 years. During this period she had been examined by four different ophthalmologists and had been treated for conjunctivitis by various combinations of antibiotic eye drops. She had also complained of a localized swelling on the nasal side of her right lower lid. She noticed that this chronic eyelid swelling expanded and shrank intermittently. The last ophthalmologist who had examined the patient wondered whether it was a chalazion or a basal cell carcinoma and referred her to us for surgical treatment.

On examination, there was clearly localized swelling and inflammation of the nasal side of the right lower lid. The area was red and indurated, simulating a chalazion. The right lower punctum was erythematous, dilated, and pouting (Fig. 1). Pressure on the medial aspect of the lid resulted in a yellow mucopurulent material being expressed from the right lower canaliculus. The discharge contained yellow "sulfur" granules. The most probable diagnosis at this stage was *A. israelii* lacrimal canaliculitis. The lower punctum was thus dilated, and yellow material with some concretions was removed from the canaliculus, using a small chalazion curette, and was immediately sent for cytologic and bacteriologic examinations.

On microscopy, both neutrophils and macrophages were present. Gram staining of the smear revealed gram-positive, thin (≤ 1 μm in diameter), branching filaments characteristic of *Actinomyces* species. Colonies of the isolate grew on vitamin K-enriched blood agar placed in an anaerobic environment. When viewed under binocular microscope, young colonies appeared as filamentous, spider-type microcolonies typical of *A. israelii*. After 10 days the mature colonies were rough, raised, heaped up, glistening, white, opaque with irregular margins (molar tooth colonies). The organism was an obligate anaerobe and did not grow on the surface of aerobic

Fig. 1. Localized swelling of the canalicular area, with mucopurulent discharge pouring through the dilated punctum (*arrow*)

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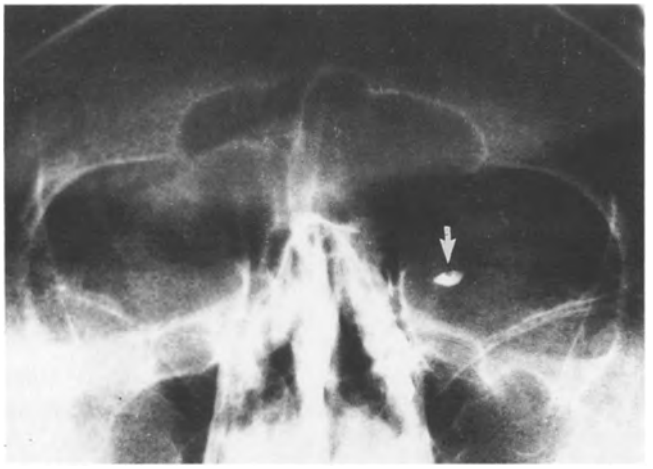

Fig. 2. Dacryocystography demonstrating the dilated right lower canaliculus (*arrow*)

plates. The results of the following tests were consistent with identification of the species as *A. israelii:* catalase production (−), indole production (−), methyl red (+), esculin hydrolysis (+), gelatin hydrolysis (−), starch hydrolysis (−), nitrate reduction (+), urease (−), and ammonia production from arginine (+). The results of fermentation tests were: glucose (+), mannitol (+), lactose (+), sucrose (+), maltose (+), xylose (+), arabinose (+), and glycerol (−). The isolate was found to be susceptible in vitro to penicillin G (MIC = 0.06 μg/ml), imipenem (MIC = 0.125 μg/ml), tetracycline (MIC = 1.0 μg/ml), and clindamycin (MIC = 0.125 μg/ml) and resistent to metronidazole (MIC = 64 μg/ml) and tinidazole (MIC = 64 μg/ml). Dacryocystography with Lipiodol Ultra Fluid (Promedico, Israel) demonstrated a dilated right lower canaliculus, with free passage of the contrast material through the nasolacrimal duct (Fig. 2).

After canalicular curettage, the patient was treated by irrigation of the canaliculus with 100000 U/ml penicillin G every second day. She was also treated with 100000 U/ml penicillin G eye drops eight times a day, combined with oral therapy with penicillin V, 800000 U four times a day.

In spite of 4 weeks of treatment there was no improvement. The patient refused any surgical procedure for removal of possible residual concretions but was willing to try hyperbaric oxygen therapy. She was therefore referred to the Israel Naval Hyperbaric Institute, where she received 24 daily hyperbaric oxygen treatment sessions (six per week) in a multiplace hyperbaric chamber, breating 100% oxygen via a mask at a pressure of 2.0–2.5 absolute atmospheres for 90 min each session. During combined antibiotic-hyperbaric oxygen treatment gradual improvement was noted. The mucopurulent discharge ceased, the eyelid swelling and inflammation regressed, and the symptoms disappeared. The patient fully recovered after 2 months and had neither epiphora nor any purulent discharge. One year follow-up revealed no recurrence. Actinomycotic lacrimal canaliculitis is an uncommon disease which is often misdiagnosed. Symptoms of persistent tearing, swelling, and tenderness of the canaliculus and chronic inflammation of the medial conjunctiva with mucoid or mucopurulent discharge may persist over a period of years [3, 11]. However, the more apparent conjunctivitis or chalazionlike tumor may obscure the presence of canaliculitis, and, as in our case, a misdiagnosis of chronic conjunctivitis or chalazion is often made. The obligate anaerobic bacterium *A. israelii* is the most common cause of chronic lacrimal canaliculitis. The recommended treatment is surgical evacuation of the canaliculus, followed by irrigation with penicillin. In rare instances, cases may be refractory to this conventional treatment [3, 8]. In our case penicillin G was chosen because the isolate was highly susceptible to this antibiotic (MIC = 0.06 μg/ml). Imipenem could not be used in this patient due to her previous history of drug-related allergic reaction (urticaria). Furthermore, due to absorption problems, imipenem can be given only intravenously, and this patient refused any additional invasive procedure, including intravenous injections. Our patient was unresponsive to canalicular curettage followed by 4 weeks of intensive treatment with penicillin given both topically and systemically, although in vitro the bacterium was sensitive to this antibiotic. Complete cure was achieved only after hyperbaric oxygen therapy was added.

Hyperbaric oxygen increases the oxygen tension in infected tissues [5]. During hyperbaric oxygen therapy, the increase in oxygen tension leads to an increase in the concentration of superoxide, both intra- and extracellularly. This in turn leads to the production of hydrogen peroxide and other toxic oxygen radicals. Possible sources of toxic oxygen metabolites could include neutrophils and macrophages, which were present in the inflamed lacrimal canaliculus. Anaerobic organisms, including *A. israelii*, are extremely sensitive to these toxic oxygen radicals, as most of them lack the superoxide-degrading enzyme superoxide dismutase and the hydrogen peroxide-degrading enzyme catalase [9]. Thus, an increase in oxygen tension, with the subsequent formation of oxygen radicals, is lethal for most strictly anaerobic organisms [4]. Moreover, leukocytic microbial killing may be enhanced by hyperbaric oxygenation [1, 5]. Favorable clinical results have been reported with adjunctive hyperbaric oxygen therapy in refractory actinomycosis [7], which is an accepted indication for hyperbaric oxygen therapy [10]. Nevertheless, hyperbaric oxygen must be used only as an adjunct to accepted antimicrobial treatment and surgical care [6].

To our knowledge, this is the first reported case in which adjunctive hyperbaric oxygen therapy has been successfully used for the treatment of lacrimal canaliculitis caused by *A. israelii*. We believe that hyperbaric oxygen may have a beneficial adjunctive effect for selected cases of refractory actinomycotic lacrimal canaliculitis.

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