Ocular Chemical Burns in the Dermatology Office: A Practical Approach to Managing Safety Precautions

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PRACTICE POINTS

- Dermatologists should be cognizant of potential hazards to the eyes during facial procedures and always take proper precautions to decrease the risk for ocular injuries.
- If a patient's eye(s) becomes exposed to a chemical during a dermatologic procedure, immediate copious irrigation for at least 15 to 30 minutes (longer for alkaline burns) is crucial, followed by prompt evaluation by an ophthalmologist.
- The patient should be instructed to manually hold open the eye and move the eyeball in all directions to achieve the most effective irrigation of the chemical.
- If the patient is wearing contact lenses, they should be removed promptly, but do not delay the irrigation to do so. Lenses should be removed once irrigation is underway.

Chemical burns to the eyes are one of the few ocular emergencies that dermatologists may encounter in their everyday clinic. As such, dermatologists should be confident in their ability to urgently manage ocular chemical injuries should accidental exposure occur during a procedure. We report a case of accidental ocular exposure to aluminum chloride hexahydrate during skin biopsy of the cheek and subsequent transient ocular injury that resolved with early appropriate management. This article provides background information on acute chemical ocular injuries, offers practical step-by-step guidance for the dermatologist, and highlights immediate copious irrigation as perhaps the most critical step in determining the clinical course of the injury.

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Many dermatologic procedures are performed on the face, such as skin biopsies, surgical excisions, and cosmetic procedures, which can increase the risk for accidental ocular injuries.[1,2] Ocular chemical burns have been reported to account for approximately 3% to 20% of ocular injuries[3,4] and are one of the few ocular emergencies dermatologists may encounter in practice. Given the potentially severe consequences of permanent vision changes or loss, it is important to take precautionary steps in preventing chemical exposures and know how to appropriately manage ophthalmic emergencies when they occur.[1,5-8] In this article, we describe a patient with a transient ocular chemical injury from exposure to aluminum chloride hexahydrate that completely resolved with immediate care. We also offer practical guidance for the general dermatologist in the acute management of acidic chemical burns to the eye, highlighting immediate copious irrigation as the most important step in preventing severe permanent damage. Given that aluminum chloride hexahydrate is an acidic solution, we focus predominantly on the approach to acidic chemical exposures to the eye.

Case Report

A 61-year-old woman was seen in the dermatology outpatient clinic for a shave biopsy on the left cheek followed by aluminum chloride application for hemostasis. Following the biopsy, the patient stated she felt the sensation that

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something had dripped into the left eye and she felt a burning pain. There was a 30- to 60-second delay in irrigation of the eye, as it was at first unclear what had occurred. The patient reported an increased burning sensation, and at that point she was instructed to begin flushing the eye with tap water from the examination room sink for 15 to 20 minutes; she wanted to stop irrigation after a few minutes, and convincing her to continue thorough irrigation was somewhat challenging. It was determined that aluminum chloride hexahydrate had dripped from an oversaturated cotton swab in transit from the tray to the biopsy site.

The patient was urgently directed to the ophthalmology clinic and evaluated by an ophthalmologist within 1 to 2 hours of chemical exposure. Visual acuity of the affected left eye was noted to be 20/30 -2 with correctional glasses, and slit lamp examination revealed moderate injection of the conjunctiva and sclera, and at least 3 punctate epithelial erosions and punctate staining of the inferior aspects of the cornea, consistent with a chemical injury. The remaining ocular examination was normal for both eyes. She was diagnosed with keratitis of the left eye from chemical exposure to aluminum chloride and was prescribed loteprednol etabonate ophthalmic suspension 0.5% and tobramycin ophthalmic solution 0.3% to be applied to the left eye 4 times daily, with follow-up 4 days later.

At follow-up, the patient denied any pain, though she was not using the prescribed eye drops consistently. On examination, the patient showed improvement in visual acuity to 20/20 -2 and complete resolution of the keratitis, with slit lamp examination showing clear conjunctiva, sclera, and cornea. Given complete resolution, the eye drops were discontinued.

Comment

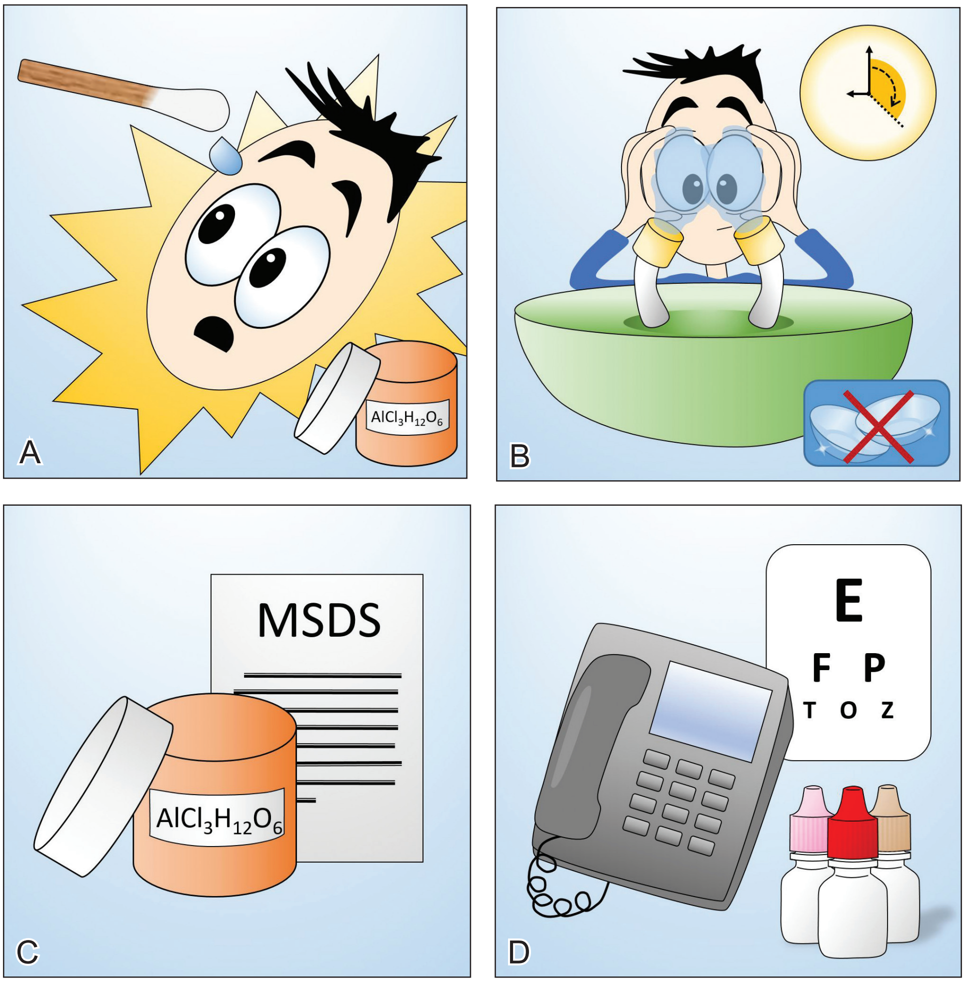
Factors Contributing to Ocular Chemical Injuries—Chemical burns to the eyes during cosmetic or surgical procedures are one of the few acute ocular emergencies dermatologists may encounter in practice. If not managed properly, the eye may be permanently damaged. Therefore, dermatologists must be confident in the initial management of ocular chemical burns (Table 1; Figure).

Mechanism of Ocular Chemical Burns—The extent of injury is predominantly determined by 2 factors: (1) the chemical properties of the substance, and (2) the length of exposure.[5,9,10] Potential chemical exposures and their reported ocular effects are listed in Table 2.[11-21] Alkaline chemical burns often have the gravest outcome, as they can rapidly penetrate into the internal ocular structures, potentially leading to cataracts and glaucoma.[9] Hydroxyl ions, often found in alkaline chemicals, are capable of rapidly denaturing the corneal matrix and triggering release of proteolytic enzymes through a series of inflammatory responses. Conversely, ocular damage from most acidic chemicals often is limited to the more superficial structures, such as the cornea and conjunctiva, given that acids may cause corneal proteins to coagulate, thus forming a barrier that slows further penetration into deeper structures.[9] Nonetheless, corneal damage can still have a devastating impact on visual acuity, as the cornea provides 65% to 75% of the eye's total focusing power.[22] For both alkaline and acidic chemicals, immediate profuse irrigation is most critical in determining the clinical course.[23-26] To provide perspective, potent alkaline chemicals may penetrate into the anterior chamber of the eye within 15 seconds,[9] and delayed initiation of irrigation by even 5 to 15 minutes may lead to irreversible intraocular damage.[27]

Symptoms of Ocular Chemical Exposure—Signs and symptoms associated with ocular chemical exposures include erythema, pain, tearing, photosensitivity, eyelid swelling, foreign body sensation, changes in vision, and corneal clouding.[3,5,9,28] Specifically, aluminum chloride hexahydrate, a hemostatic agent commonly used by dermatologists, has potentially caused eye irritation and

TABLE 1. Initial Management Steps for Ocular Chemical Injuries

Clinical Pearls
Immediately begin irrigation for 15 to 30 minutes (or longer for potent chemicals) with at least 1 to 2 L of irrigation fluid until the pH is between 7 and 7.2. Patients may attempt to discontinue irrigation after a few minutes; however, it is important to convince them to irrigate for the full time, even if they are no longer experiencing the initial symptoms. Delays or insufficient irrigation may lead to greater complications.
Remove contact lenses as soon as practical, but do not delay irrigation to wait for contact lens removal. Some sources recommend removing contact lenses several seconds after irrigation or as soon as practical.[6,8]
Ensure patients keep eye(s) wide open. Patients may need to manually pry their eyes open.
Ask patients to move their eye(s) in all directions while irrigating to ensure all ocular surfaces are irrigated.
If using a sink, set the faucet valve to provide a gentle stream of lukewarm water.[7]
Verify the chemical substance and, if possible, obtain the material safety data sheet.
Refer urgently to ophthalmology or emergency department for evaluation.



A, When using aluminum chloride hexahydrate ($AlCl_3H_{12}O_6$), ensure eye safety precautions. B, Irrigate the affected eye(s) for at least 15 to 30 minutes. Remove contact lenses as soon as practical or after several seconds of immediate irrigation.[6,8] Patients should keep eyes wide open and rotate their eyes in all directions. C, Identify and verify the chemical and, if possible, obtain the material safety data sheet. D, Refer the patient urgently to ophthalmology for a visual acuity test and treatment. Images courtesy of Deborah J. Moon, MD (Los Angeles, California).

TABLE 2. Potential Chemical Exposures and Their Ocular Effects

Chemical	Ocular Effect
Chlorhexidine gluconate 4%	Corneal edema, keratopathy, and reports of severe permanent corneal opacification[12-15]; chlorhexidine should not be used on the face around the eyes, ears, nose, or mouth due to its grave complications
Chlorine bleach (sodium hypochlorite) 3% to 15%	Alkaline chemical[16] with reports of burning discomfort and slight damage to corneal epithelium that resolved with prompt rinsing and appropriate attention[17]
Hydrogen peroxide	Ocular irritation, punctate keratitis, hyperemia; possible permanent injury such as corneal ulceration with exposure to high concentrations (>25%)[11]
Hypochlorous acid (HClO 0.01% and 0.02%)	Ingredient in eyelid hygiene solutions; may be used for blepharitis[21]
Povidone iodine 5%	Used for preoperative preparation of the eye for ocular surgery[19,20]
Rubbing alcohol (isopropyl alcohol)	Epithelial keratitis, ocular surface irritation, possible corneal abrasion[11]
Salicylic acid	Case report of conjunctival epithelial defect and edema from accidental salicylic acid (20%) exposure with resolution with treatment[18]

TABLE 3. Chemical Injury Classification, Prognosis, and Management

Roper-Hall[37] Classification	Signs	Prognosis	Management
Grade I	Damage to corneal epithelia; no limbal ischemia	Good	Copious irrigation; mild topical antibiotic, artificial tears, topical steroids, and possibly topical cycloplegic for comfort; follow-up at least every other day until complete healing of ocular surface; long-term follow-up for complications may be recommended
Grade II	Mild corneal haze; focal limbal ischemia	Good; however, may develop focal corneal haze and neovascularization	Copious irrigation; broad-spectrum topical antibiotic, oral antibiotic, topical prednisolone acetate with rapid tapering to reduce risk for corneal melting, cycloplegic for comfort with oral pain medications, possibly high-dose vitamin C to promote healing, and, if applicable, eye drops for elevated intraocular pressure; surgical treatments may be recommended depending on injury; daily monitoring; long-term follow-up for complications also recommended
Grade III	Profound corneal haze, complete corneal epithelial loss; significant limbal ischemia	Guarded—often without visual improvement, unless surgical intervention is offered	
Grade IV	Opaque cornea; ischemia of majority of limbus	Poor—possibly without visual recovery	

Data from Hemmati and Colby.[9]

conjunctivitis, according to its material safety data sheet,[29] as well as blepharospasms, transient disturbances in corneal epithelium, and a persistent faint nebula in the corneal stroma.[30] Similar antiperspirants also showed damaging effects to bovine lenses, ocular irritation, and subjective reports of burning and watery eyes.[31-33]

Immediate Management—If potential chemical exposure to the eye is suspected either by the health care provider or patient, immediately irrigate the affected eye(s) for at least 15 to 30 minutes (longer for alkaline burns) with at least 1 to 2 L of irrigation fluid until the pH is between 7 and 7.2.[3-5,9,27,34,35] Irrigation fluids reported to be used include normal saline, Ringer lactate solution, normal saline with sodium bicarbonate, and balanced salt solution.[5] If no solutions are readily available, immediate irrigation with tap water is sufficient for diluting and washing away the chemical and has been reported to have better clinical outcomes than delaying irrigation.[5,24-26] Studies have shown that prolonged irrigation corresponded with reduced severity, shortened healing time, shorter in-hospital treatment duration, and quicker return to work.[5,26]

If an eye wash station is not available, the patient can gently flush the eye under a sink faucet set to a gentle stream of lukewarm water.[6,7] The health care provider also may manually irrigate the eye. Necessary equipment includes a large syringe or clean eyecup, irrigating fluid, local anesthetic drops for comfort, a towel to soak up excessive fluid, and a bowl or kidney dish to collect the irrigated fluid.[34] Providers should first wash their hands. If necessary, anesthetic eye drops may be added for comfort. Lay a towel over the patient's neck and shoulders and position the patient at a comfortable angle. Place a bowl adjacent to the patient's cheek to collect the irrigating fluid and have the patient tilt his/her head such that the irrigated fluid would flow into the bowl. Pour a steady stream of the irrigating fluid over the eye from a height of no more than 5 cm.[6,7,34]

During irrigation, ensure that the patient's eye(s) is wide open and that all ocular surfaces, including the area underneath the eyelids, are thoroughly washed; everting the eyelids may be beneficial. Ask the patient to move his/her eye(s) in all directions while irrigating. If available, place a litmus strip in the conjunctival fornix to ensure that the goal pH of 7 to 7.2 is reached.[9] The pH should be rechecked every 15 to 30 minutes to ensure there has been no change, as hidden crystalized chemical particles may continue to elute chemicals, causing further injury.[3] Contact lenses, if present, should be removed as soon as practical, as lenses can trap chemicals; however, immediate initiation of irrigation should not be delayed[8] (Table 1).

Identify and verify the chemical suspected to have been exposed to the patient's eye. The material safety data sheet, which may often be found online if a hard copy is not available, may provide valuable information for the ophthalmologist.[36] After thorough irrigation, refer the patient urgently to ophthalmology or the emergency department for prompt evaluation. The emergency department is frequently equipped with polymethylmethacrylate scleral lenses, also called Morgan Lens, which consist of a plastic lens connected via tubing to a bag of irrigation fluid (eg, Ringer lactate solution), allowing for prolonged continuous irrigation of the conjunctiva and cornea. The ophthalmologist will conduct a visual acuity test and complete a thorough eye examination to assess the extent of ischemic injury to the conjunctiva or sclera and damage to the corneal epithelium and internal ocular structures.[9]

Generally, topical antibiotics, artificial tears, and topical steroids may be provided to patients with mild injury with close follow-up.[9,37] For higher-grade injuries, broad-spectrum topical antibiotics, oral antibiotics, topical corticosteroids, vitamin C, and surgical treatments may be additionally recommended (Table 3). Long-term follow-up may be recommended by the ophthalmologist to monitor for potential late complications, such as glaucoma from damage to the trabecular meshwork, corneal abnormalities and limbal stem cell deficiency, symblepharon formation, or eyelid abnormalities.[9]

Conclusion

We report a case of a transient chemical burn to the eye secondary to exposure to aluminum chloride hexahydrate. Complete resolution of the injury was achieved with prompt irrigation and urgent medical management by ophthalmology. This case emphasizes the potential for ocular emergencies in the dermatology setting and highlights the steps for appropriate management should a chemical burn to the eye occur. We emphasize the importance of immediate profuse irrigation for 15 to 30 minutes and urgent evaluation by an ophthalmologist. Dermatologists should be cognizant of potential hazards to the eye during facial procedures and always take proper precautions to decrease the risk for ocular injuries.

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