CASE REPORT

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# Left ocular alkali injury: a case report

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## ABSTRACT

**Background:** Chemical injury represents an ocular emergency caused by sudden exposure to high (alkalis) or low (acids) pH substances. Such cases often inflict on individuals at productive age, whom 70% of which are male. Approximately 63% of chemical injuries occur in industrial setting. Classification based on the degree of severity it caused is applied to determine appropriate management and prognosticate outcome. Signs and symptoms observed including pain, photophobia, decreased level of visual acuity, hyperemic conjunctiva, and elevated intraocular pressure (IOP).

**Case:** We describe an outpatient from Sanjiwani Gianyar General Hospital eye polyclinic in Agustus 2019. A 25-year-old woman presented with pain in the left eye after inadvertent caustic soda splash. Ophthalmic examination revealed conjunctival vascular injection (CVI) and pericorneal vascular injection (PCVI) along with positive fluorescein staining of the left eye. She was diagnosed with alkali-related chemical injury with complicating corneal erosion. Therapeutic measure instituted were ocular irrigation using Ringer's lactate solution, oral and topical antibiotics, topical steroid, and oral analgesics. Her good prognosis should be ascertained with close follow-up.

**Conclusion:** The main principle of injury management is to remove offending agent and maintain ocular surface pH within normal limit.

**Keywords:** ocular injury, chemical injury, acid, alkali

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## INTRODUCTION

Ocular chemical injury or burn constitutes the most serious ocular emergencies. Causative agents are comprised of varying pH substance, ranging from acidic (low pH) to alkaline (high pH).[1] Most cases occur in individuals between the ages of 16 to 45 and predominantly (70%) male. Industrial setting (63%) usually provides supporting circumstances, although household incidence is not uncommon. While majority of cases are considered benign, hospitalization is required in 8% cases and less than 1% suffered from permanent vision loss.[2,3]

Acidic or alkaline property of a substance is determined by whether the pH value measures less or more than 7, respectively. The strength of this property of an offending agent is closely related to the severity of damage it inflicted. Common examples of alkaline substances are ammonia, caustic soda, magnesium hydroxide (fireworks), and lime (adhesive, mortar, cement, chalk); while the acidic counterparts are sulfuric acid (car battery), sulfurous acid (fruit and vegetable preservatives), hydrofluoric acid (rust remover), acetic acid (vinegar), hydrochloric acid (cleaning substance), chromic (colorant in dye, ink, or glass).[2,4]

Alkaline substance is lipophilic in nature, hence is deposited quickly in ocular surface tissues while causing saponification. This particular reaction allows for further deep tissue penetration. Acidic substance, on the other hand, leads to barrier formation that inhibit deeper penetration through protein coagulation. The difference in the cascade of reactions contribute to the more significant hazard alkali-related injuries poses over acid-related ones.[5,6]

The diagnostic process in ocular chemical injury requires proper history taking and examination. Ocular examination findings consist of pain, photophobia, impaired visual acuity, conjunctival hyperemia, chemosis, perilimbal ischemia, stromal haze, corneal perforation, flare, and increased intraocular pressure (IOP). In severe cases, ischemia in conjunctival vessels caused white instead of red appearance of the eye. The total surface area in contact with causative agent is assessed with fluorescein staining pattern on corneal or conjunctival epithelium. Classification system based on clinical severity serves as treatment and prognostication guidance. Ocular injury is divided

into four distinct grades depending on corneal and limbal damage in Roper-Hall classification system.

The cornerstone in chemical injury management relies upon offending agent removal while maintaining normal ocular surface pH. Prompt management with normal saline irrigation, oral and topical antibiotics administration, topical steroid, and artificial tears, with additional cycloplegic reserved for moderate to severe cases.

## CASE DESCRIPTION

We present a case from Sanjiwani Gianyar General Hospital eye polyclinic in August 2019. A 25-year-old female patient presented to the emergency department with pain in the left eye following an unexpected splash of caustic soda 15 minutes prior to admission. She was immediately referred to the ophthalmology clinic. The self-inflicted injury took place in a working situation as she did not comply with proper safety precaution by applying eye protection. Other complaints including blurry vision, glare, and redness in the left eye. There was not any notable previous medication history apart from eye irrigation using 500 ml Ringer's lactate (RL) solution in the emergency department. She denied any history of ocular trauma, surgery, or need for spectacles. Systemic diseases such as diabetes and hypertension were denied.

She was fully alert and moderately ill in general appearance. Vital signs measurements recorded comprising blood pressure 110/70 mmHg, heart rate 80 beats per minute, respiratory rate 16 times per minute, and axillary temperature 36°C. Head and neck, thorax, abdomen, and extremity physical examination were within normal limit. On ophthalmic examination her visual acuity were 6/6 and 6/30 for right and left eyes, respectively. The left eye was watery with mixed type of injection consisting of both CVI and PCVI, round pupil with 3 mm diameter, isocoria, and bilateral positive pupillary light reflex. Fluorescein staining with cobalt blue light detected superficial erosion in the left cornea. Slit-lamp examination revealed no limbal ischemia with clear iris details. Examination of the right eye was unremarkable. Digital palpation approximated normal bilateral IOP. She was diagnosed with alkali-related chemical injury in the left eye with corneal erosion.

This patient underwent initial management with 500 ml RL solution irrigation in the injured side. She was discharged and received Tobroson® 1 drop 6 times daily, ciprofloxacin 500 mg twice daily, and mefenamic acid 500 mg thrice daily as take-home medications. She was advised to have a follow-up visit the week after or sooner if indicated, avoid rubbing her eyes, use eye protection (e.g. goggles, bandage) to prevent infection, and take her medications as prescribed. The case had a good prognosis.

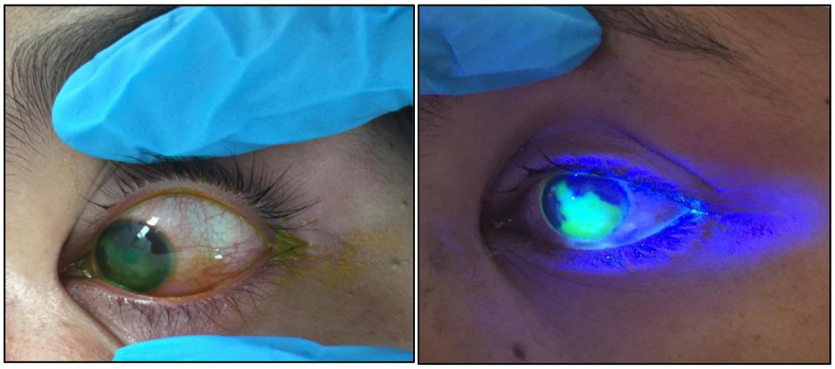

**Figure 1.** Fluorescein test in the left eye

## DISCUSSION

We presented a case of 25-year-old female with pain in the left eye due to caustic soda exposure. Ocular chemical injury is considered an emergency, thus urging timely and accurate management. The injury it imposed depends on several factors, namely substance strength in acidity or alkaline property, amount or dose, and exposure duration. Injury likelihood increases within the age range of 16 to 45 year, male gender (70%), and in industrial setting (63%).[3,4] This particular case partially complied to the former characteristics, depicting an individual at her productive age working in an industrial environment.[2]

The degree of acidity is referred to as pH, where values further from 7 yields greater strength in acidity or alkaline property and therefore greater damage it causes. A chemical substance possessing pH lower than 7 is called acidic, while the opposite applies to alkaline with pH value exceeding 7. Based on caustic soda exposure she admitted in history taking, we could conclude that it was an alkali-related injury. Caustic soda is a generic term for a strong alkali with chemical formula Na(OH). It was safe to assume that this accident involved only minute amount of the dangerous substance.[1,3]

The patient also experienced blurry vision, glare, redness, and tearful in the left eye. Sudden decrease in visual acuity could be contributed by corneal epithelial defect, stromal haze, lacrimation, or discomfort. In addition to blurry vision, glare or photophobia resulted from iris inflammatory contraction in which iris blood vessel dilatation occurred as a reflex response towards corneal nerve irritation. Redness did not only reflect conjunctival

**Table 1. Roper-Hall classification system[9]**

| Grade | Corneal involvement | Limbal ischemia | Prognosis |
|---|---|---|---|
| I | Epithelial damage | None | Very good |
| II | Haze, but iris details are visible | < 1/3 | Good |
| III | Total epithelial loss with haze obscuring iris details | 1/3 – 1/2 | Guarded |
| IV | Opaque cornea with obscured iris and pupil | > 1/2 | Poor |

inflammation but also excluded the possibility of severe injury which usually portrayed white ischemic appearance.[5]

Detailed examination of the left eye revealed both conjunctival and pericorneal vascular dilatation from expanding inflammatory reaction reaching posterior conjunctival and anterior ciliary artery. Subsequent complicating corneal erosion developed from alkali dissociation into hydroxyl ion and cation on the ocular surface. Hydroxyl ion led to saponification of cell membrane fatty acid, whilst cation interacted with stromal collagen and glycosaminoglycan. This interaction facilitating deeper penetration through corneal layers into anterior segment substantiate appalling injury imposed by alkalis compared to acids.[5-7]

Fundamental principles in managing chemical injury are offending agent elimination and normal ocular surface pH maintenance. Management should be initiated as soon as possible to better preserve visual function. Immediate irrigation using 500 ml RL solution was done accordingly. Ringer's lactate solution remains the mainstay in chemical injury management for its neutral pH which helps to avoid unnecessary damage. Tobroson® eyedrop contains steroid and tobramycin. Corneal, conjunctival, and scleral injury necessitate topical prophylactic antibiotic administration in drops or ointment vehicle. Broad-spectrum antibiotics preferred are tobramycin, gentamycin, ciprofloxacin, norfloxacin, and bacitracin. Neomycin and sulfa drugs are generally avoided for their allergic risks. Topical steroid aids in controlling inflammatory process by inhibiting neutrophil infiltration and its following corneal collagenase accumulation along with fibroblast formation. Steroid duration should not exceed one week because prolonged use could prevent collagen production, which increases the risk of corneoscleral melt. Additional oral antibiotic (ciprofloxacin 500 mg bid) and analgesics were prescribed in this case.[5,7,8]

Roper-Hall classification system divided chemical injury into four grades according to the extent of corneal and limbal conjunctival damage (Table 1). Recovery prognosis and injury severity are assessed from the degree of conjunctival and limbal vessels ischemia. In this case, we found grade I injury with corneal epithelial injury in the absence of limbal ischemia.[9]

## CONCLUSION

Chemical injury is a part of ocular emergencies requiring immediate and effective management. A chemical substance is warranted acid or alkali if the pH value measured below or over seven respectively. Alkali causes more severe damage than its acid counterparts for its hydrophilic and lipophilic properties that allows rapid membrane penetration into the anterior chamber and even retina. Diagnosis establishment of chemical injury is based on the history of chemical substance exposure and ensuing epiphora, pain, and redness. Classification system helps to navigate management strategy and prognosticate outcome. The importance of ocular irrigation is surmounted in prompt management plan. Supporting medications prescribed including antibiotics, steroid, and analgetics. Close follow-up and diligent eye protective measures are vital in improving the outcome.

## CONFLICT OF INTEREST

None

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