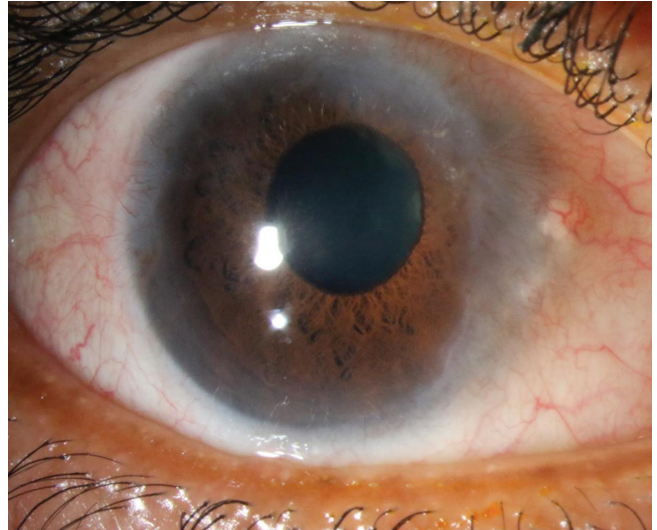


# Chemical injury

BY ABDUL TARIN

You are the on-call ophthalmologist. You receive a call from A&E regarding a 45-year-old man who sustained a chemical injury. He was mixing some cement, when a small amount entered his left eye. He was not wearing any protective goggles. He has been irrigated extensively by the nurses, and they report the pH is now 7.0. What are the features to assess and how should we proceed?



## Emergency management

In the first instance, the pH should be measured again in both eyes using litmus paper to verify normalisation. Aim for a target between 7.0 and 7.4.

Gently insert the litmus paper in both fornices and observe the colour.

Do not forget to also check the pH in the unaffected eye for comparison. Ensure the colour appears similar in both eyes before proceeding.

If it is still too low or too high, or significantly different from the other eye, then continue irrigation with 2L of normal saline. This may take a while, but will ensure any particulate is removed.

NEVER use acidic solutions to neutralise alkalis, or vice versa.

An eyelid speculum and topical anaesthetic (e.g. propracaine) may be placed prior to irrigation, although this would likely be washed away.

Upper and lower eye fornices need to be everted and irrigated.

Re-check the pH five to ten minutes after irrigation is completed [1].

## History

Document the following:

- Time of injury
- Specific type of chemical
- Time between exposure until irrigation was started
- Type of irrigation fluid used
- Duration / amount of fluid irrigated
- Was the patient wearing any eye protection?

## Examination

### Eyelids

- Assess the blink, lid movements and observe for lagophthalmos. This can be caused by excessive burns to the lid and lid margins [2].
- Look for swollen lids.
- The presence of abnormal lid movements and distorted lid margins affects tear distribution. Dry eyes can contribute to ocular surface pathology.

### Ocular surface epithelium

- Pull down the lower eyelid and gently touch the bulbar conjunctiva with a fluorescein strip loaded with a few droplets of saline. This is quickly spread across the ocular surface compared to fluorescein drops.
- Examine the lower palpebral, inferior forniceal and bulbar conjunctiva for any epithelial damage and retained particulate. Ensure to evert the upper eyelids as well.
- Look for any blanched or pale areas around the corneal limbus, which would indicate limbal ischaemia. This would suggest damage to limbal stem cells, and can significantly impair the healing process.
- Look for:
  - Haemorrhages
  - White marble appearance of limbus and sclera
  - Corneal haze
  - Corneal opacification
  - Corneal oedema
- Check the visibility of the iris and lens. If it is cloudy, it suggests corneal haze.
- Assess corneal sensation by gently applying a cotton wisp once the topical anaesthetic has worn off.

### Intraocular anterior segment structures

- Look for iris changes – assess for colour, hyperaemia / engorged vessels, haemorrhages, necrosis and pigment dispersion.
- Posterior and anterior synechiae.
- Check pupillary responses.
- Check intraocular pressure (IOP)
  - Avoid iCare and Tonopen devices as collagen shrinkage from chemical injury and corneal oedema can cause inaccurate readings
  - Sometimes if there is extensive damage to the epithelium, the readings from a Goldman can also be inaccurate.
  - There can be a double spike in IOP. The first spike is from sudden distortion of the drainage angle due to shrinkage of the cornea and sclera
  - The second spike results from clogging of the trabecular meshwork with debris.
- A swollen lens can cause a phacomorphic glaucoma.
- Examine the vitreous and retina if able. Look for vascular stasis and retinal haemorrhages.

## Classification

There are two classification systems that can be used to classify the prognosis in chemical injury [2].

Roper Hall Classification			
Grade	Cornea	Limbus	Prognosis
1	Corneal epithelial damage	No limbal ischaemia	Good
2	Corneal haze, iris details visible	<1/3 limbal ischaemia	Good
3	Stromal haze, iris details obscured	1/3 – 1/2 limbal ischaemia	Guarded
4	Opaque cornea, iris and pupil obscured	>1/2 limbal ischaemia	Poor

Dua Classification				
Grade	Prognosis	Clock Hours of Limbal Involvement	Conjunctival Involvement	Analogue Scale*
I	Very good	0	0%	0/0%
II	Good	≤3	<30%	0.1-3/1-29.9%
III	Good	3 – 6	30 – 50%	3-6/30-50%
IV	Good to guarded	7 – 9	51 – 75%	6.1-9/51-75%
V	Guarded to poor	9 - 11	76 – 99%	9.1-11/76-99%
IV	Poor	12	100	12/100%

\*The analogue scale records the clock hours of limbal involvement divided by percentage of conjunctival involvement.

## Management

### Control of acute inflammatory response

- Use topical, preservative-free corticosteroids for the acute inflammatory response [3].
- Preservative free (PF) preparations help to reduce additional stress on the ocular surface.
- Potent steroids like dexamethasone 0.1% and prednisolone 1% can be used.
- The downside is that steroids can impair the corneal healing process and collagen re-formation.
- It is ideal to taper the dose or frequency of topical steroids seven to ten days after the injury, although longer durations can be used if there is daily monitoring or complete re-epithelialisation of the cornea has been achieved.
- Tetracyclines (oral doxycycline 100mg BD), sodium citrate, acetylcysteine and Na<sub>2</sub>Ca-ethylendiaminetetraacetate (EDTA) reduce or prevent corneal ulceration .
- Amniotic membrane transplant expedites the healing process of damaged corneal epithelium, reduces pain and improves visual outcome in moderate injuries (Dua grade 2-3).

### Facilitation of the healing process

- Next step is to facilitate healing process of damaged ocular surface
- PF artificial tears
- Ascorbic acid (vitamin C) 5-10% topically, 1-2g/day orally
- Umbilical cord serum (UCS)
- Bandage contact lens to protect

- Mydriatic / cycloplegic agents to treat iridocyclitis and break / prevent synechiae
- Adrenergic agents should be avoided – cause vasoconstriction and can worsen limbal ischaemia
- Broad spectrum antibiotics for prophylaxis – fluoroquinolones (ciprofloxacin, levofloxacin) as monotherapy
- In presence of infection, drugs tailored to microbes identified through culture and sensitivity tests
- IOP lowering agents – oral acetazolamide.

### Late-stage management

- MDT to deal with main areas that require reconstruction
  - Lids – repair and reconstruction
  - Adnexa
  - Eye pressure
  - Cataract
  - Ocular surface
  - Cornea
- Dry eye disease (sequelae) – artificial tear drops.

### References

1. Bagheri N, Wajda B, Calvo C, Durrani A: *The Wills Eye Manual*. 7th ed. Hagerstown: Wolters Kluwer Health; 2017.
2. Dua H, Ting D, Al Saadi A, Said D. Chemical eye injury: pathophysiology, assessment and management. *Eye* 2020;**34**(11):2001-19.
3. Morgan S. Chemical burns of the eye: causes and management. *Brit J Ophthalmol* 1987;**71**(11):854-7.

### TAKE HOME MESSAGE

- A thorough systemic examination is key.
- Remember to evert the eyelid for any retained particulate .
- Check for limbal ischaemia and areas of blanching, which suggests poorer prognosis.
- Check IOP with Goldman, but keep in mind this may give false results.
- Give topical steroids and taper after seven to ten days, PO doxycycline 100mg BD, sodium citrate, acetylcysteine and EDTA.
- Refer to acute cornea.

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