Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Visual Case Discussion

Hand sanitizer associated ocular chemical injury: A mini-review on its rise under COVID-19

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1. Visual Case Discussion

A 32-year-old lady attended the emergency department for left eye pain after accidental splitting of alcohol-based hand rub gel into the left eye by herself. She was not on contact lens or goggles, and never had corneal or laser refractive surgery before. As a practice of hand hygiene under COVID-19, she was applying her pocket-sized instant hand sanitizer gel (Fig. 1) over her left hand after touching the public facilities. It was an alcohol-based gel with 70% denatured alcohol, phenoxyethanol, mixed with glycerin and melaleuca alternifolia leaf oil. Unluckily, the bottle was almost finished, and she was trying hard with her right hand to squeeze out the last bit when the gel suddenly ejected straight into her left eye. She experienced instant pain, and blurring of vision persisted despite repeated blinking. The pain was so intense few moments later that she could not even open her left eye or blink. She was accompanied by her colleague to attend the emergency department, but there was no self irrigation done before her arrival.

Treated as chemical injury, the triage nurse revealed no systemic burns or periocular injury. Immediate irrigation was done at triage, and test on pH was 8. Topical anesthetic eye drop was instilled, and ocular irrigation device (Morgan Lens, Fig. 2) was then inserted. Irrigation by 2 L normal saline was given at full rate before formal eye assessment.

With some improvement, patient was examined at slit lamp. There was no limbal ischemia (Fig. 3); cornea was haze yet iris details were clearly visible. Fluorescein stain showed ~80% central corneal epithelial defect (Figs. 3 and 4; Video 1), but no conjunctival involvement (Fig. 4). Without any history of Laser in situ keratomileusis (LASIK), the corneal defect was unlikely caused by LASIK flap dislodgement, a rare complication of continuous irrigation. Repeated pH test was still alkaline (Fig. 5), probably from the remaining viscous sanitizer gel over the fornices which resisted to just normal saline irrigation. Therefore, fornices were swabbed few times with eversion (Fig. 6) before proceeding to further irrigation. Further 6 L irrigation was done before pH was neutralized. Patient was prescribed with topical antibiotics and lubricating eye drops, oral analgesia and ascorbic acid of 1 g BD. The corneal defect was healed gradually in 2-week times, and final visual acuity was 0.9 Snellen decimal without any permanent visual loss.

With increasing COVID-19 infected cases of >25 million worldwide, people around the world are practicing strict personal hygiene against infection.[1] Alcohol-based hand sanitizer was one of the best sellers, and its associated accident was also on rising trend. From our hospital data, there were only 1 –2 cases annually before the COVID-19 era, which most were healthcare workers' accidental injuries on duty. Since the local COVID-19 outbreak 3 months ago,[4] there were already 5 cases of personal hygiene gadgets associated ocular injury. Other than the hand sanitizer as described, ocular phototoxicity from ultraviolet lamp misuse was also reported.[5] In addition, sanitizer aerosol-driven ocular surface disease (SADOSD) was raised in recent ophthalmology literature.[6]

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Fig. 1. Alcohol-based hand sanitizer gel. Patient showed us another new tube of her pocket-sized instant hand sanitizer. Note the flammable warning label over the bottle due to its alcohol-based nature. The hand sanitizer gel is quite viscous judged from those air bubbles trapped inside the gel content, hinting its resistance towards barely water irrigation. Manual swabbing of the fornices was required to avoid retain of chemical gel causing continuing ocular damage over the blind-ended sacs.

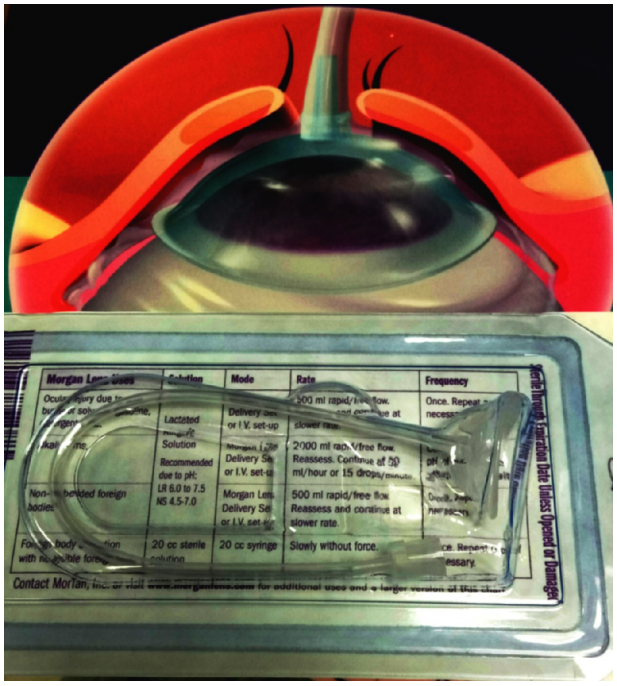

Fig. 2. Ocular irrigation device. This contact lens type of irrigation device is connected with tubing as illustrated by the cartoon drawings on its package. It comes in individual sterile package, and is made of rigid plastic which supports the opening of both upper and lower fornices upon continuous irrigation. Irrigation solution would go over the space between the ocular surface and the device, then towards the fornices before overflowing out of the injured eye.

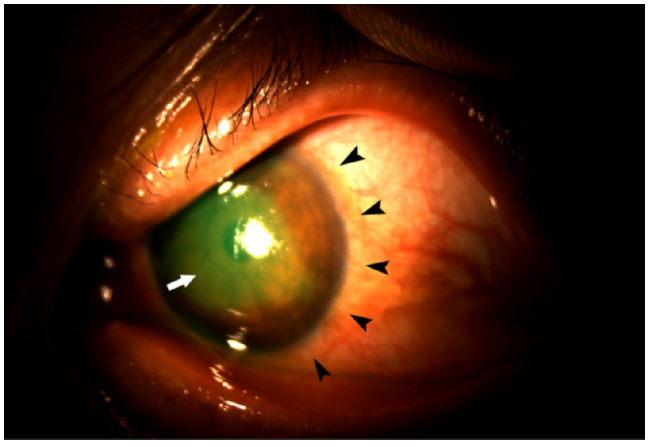

Fig. 3. Slit lamp photo of the patient's left eye. Conjunctival injection was evidenced (black arrowheads) without any limbal ischemia, which would have appeared as blanched vessels without visible blood flow, thus whitish in color. Corneal defect was stained as green color by fluorescein, and the underlying iris details (white arrow) were well seen on slit lamp. There was neither anterior chamber cell nor fibrin. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

As a matter of fact, alcohol is widely used in different ocular surgeries. Ophthalmologists are familiar with the 20% ethanol usage in laser refractive surgery such as photorefractive keratectomy (PRK), laser subepithelial keratomileusis (LASEK), or in treatment of corneal diseases like corneal collagen cross-linking (CXL) for keratoconus, alcohol delamination of epithelium for recurrent corneal erosion (RCE) patients etc. During these ophthalmic procedures, alcohol is applied on cornea with the metal well. It weakens binding of corneal epithelial hemidesmosomal attachment to the underlying Bowman's layer, allowing complete removal for further operations. However, the component of ethanol in alcohol-based hand sanitizers ranges usually from 60 – 95%, which is much higher than ophthalmic usage. This high concentration of alcohol is associated with increase in inflammatory response, cellular stress and damaging effects on keratocytes.

Chemical injury of the eye is almost the only ocular emergency that should be treated before formal history and clinical assessment. Different classifications for ocular chemical burns are available; which the widely accepted Roper-Hall[2] and Dua[3] classifications took into account of corneal clarity, limbal ischemia and conjunctival involvement to determine the prognosis. Most cleansing agents are alkali, unfortunately alkaline burn is worse than an acidic burn. It is because acid triggers tissue coagulation, and the coagulum acts a natural barrier preventing further depth penetration of the acidic chemicals. Concerning ocular treatment, on site instant irrigation with copious amount of water is essential to dilute the offending chemicals. Fornices swabbing is essential to remove residual over the blind-ended sac in case of persistent abnormal pHs. (Fig. 6) Prolonged irrigation is sometimes needed for persistent abnormal pHs, when ocular irrigation device would be less labor-intensive and more comfortable to patients. The rigid contact lens-shaped design of Morgan lens supports the opening of both upper and lower fornices upon continuous irrigation. (Fig. 2) Prior to insertion, the lower eyelid is first pulled down to allow space for insertion of the lower lip of the device; next retraction of the upper eyelid allows adequate exposure of the interpalpebral area to insert the whole device over the cornea. Irrigation solution would go over the space between the ocular surface and the device, then towards the fornices before overflowing out of the injured eye. Following acute

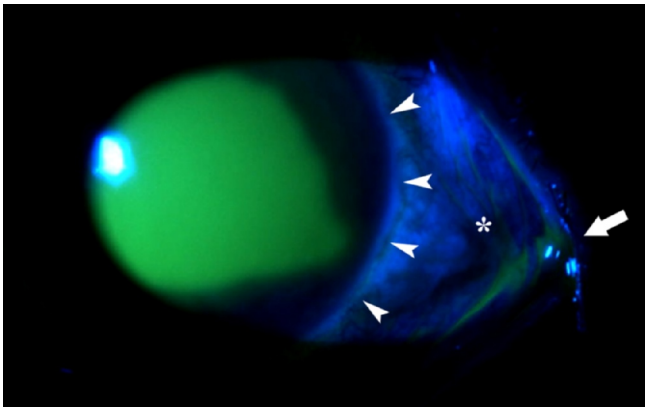

Fig. 4. Slit lamp view with blue filter over the fluorescein stained left eye. Large area of the central cornea (~80%) was stained up (green color area), suggestive of corneal epithelial defect. Temporal conjunctiva (white asterisk) shown in this figure revealed no conjunctival involvement. The anatomical landmark of the limbus and the lateral canthus were pointed out respectively by the arrowheads and the arrow. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 5. pH test of the inferior fornix. The soaked fluid from the ocular surface showed an alkaline pH value of ~8, higher than the physiological pH. Further irrigation was continued after swabbing of fornix as shown in Fig. 6.

care, physicians could prescribe topical lubricating eye drops, oral analgesic and ascorbic acid to promote the ocular surface healing.

In short, hand sanitizer is at risk of ocular chemical injury, and emergency physicians should be expecting more cases during the COVID-19 pandemic. Proper management of the chemically injured eyes would save the victims' vision.

Question 1:

In an alkaline chemical injured eye by household cleansing agent, which of the following clinical signs points towards poor prognosis?

A) Corneal epithelial defect of 1 mm in size
B) Cornea haze without opaque cornea
C) Iris details visible
D) Limbal ischemia involving 10 clock hours' area
E) 30% of conjunctival involvement from chemical burns

Correct answer: (D) Limbal ischemia involving 10 clock hours' area

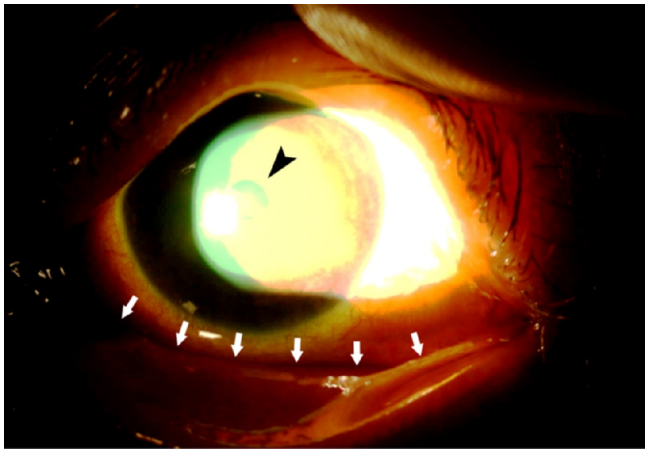

Fig. 6. Slit lamp photo illustrating inferior fornix eversion. White arrows outlined the area over the inferior fornix. Cotton tip applicator soaked with saline was further inserted deep into the fornix to swab away the remaining sanitizer gel. Black arrow head pointed at the normal pupil demonstrated constriction to light without any traumatic mydriasis.

Discussion & rationale:

Small corneal epithelial defect is of good visual prognosis, unless the lesion depth is beyond the Bowman's layer and over the central visual axis.

According to the Roper-Hall classification of severity of ocular surface burns (1965),[2] grade IV chemical injured eyes with opaque cornea, iris details obscured, and >50% of limbus showing ischemia are of poor prognosis. Conjunctival involvement was not addressed by the Roper-Hall classification; instead Dua's new classification in 2001 highlighted this.[3]

In Dua classification,[3] grade V or above with >75% conjunctival involvement, and >9 clock hours of limbal ischemia are of guarded to poor prognosis.

Question 2

After the acute management of the chemical injured eye with copious amount of normal saline irrigation, there was a 1.5 mm x 2 mm corneal defect. In addition to topical antibiotics, which of the following is indicated to promote his/ her corneal healing?

a) Oral prednisolone of 1 gram
b) Oral ascorbic acid of 1 gram
c) Topical alpha-2 receptor agonist eye drop, e.g. apraclonidine 1%
d) Topical beta-blocker eye drop, e.g. timolol 0.5%
e) Topical muscarinic receptor (cholinergic) agonist/ parasympathomimetics eye drop, e.g. pilocarpine 4%

Correct answer: (b) Oral ascorbic acid of 1 gram

Discussion & rationale:

Ascorbic acid reverses a localized tissue scorbutic state and improves wound healing, promoting the synthesis of mature collagen by corneal fibroblasts. It is an effective scavenger of damaging free radicals. Both topical (e.g. sodium ascorbate 10%) and systemic ascorbic acid of high dose (e.g. Vitamin C 1 gram BD) are effective. However, usage of ascorbic acid should be avoided in acidic chemical burns and renal patients.

Steroids reduce inflammation and neutrophil infiltration, but impair stromal healing by reducing collagen synthesis and inhibiting fibroblast migration. Topical steroids may be used initially, but must be tailed off after 7–10 days. Oral prednisolone of 1 gram is not necessary, and is harmful at such a high dose.

Topical alpha-2 receptor agonist eye drop, e.g. apraclonidine 1%, is used as therapeutic eye drop to lower intraocular pressure (IOP), or as pharmacological test to confirm a Horner pupil, which will dilate

30 min after instillation and even improves the associated ptosis.

Other IOP lowering agents are topical beta-blocker eye drop, and topical muscarinic receptor (cholinergic) agonist/ parasympathomimetics eye drop. They are not necessary in chemical injured eyes, unless complicated with secondary glaucoma.

Video 1: Slit lamp examinations of the fluorescein stained ocular surface with blue filter. The corneal defect was obvious, whereas the conjunctiva was spared from any injury.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.visj.2020.100881.

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