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Inadvertent Use of More Potent Acid Leads to Burn

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The Case

A 31-year-old woman came to the clinic for a routine well-woman evaluation. She has a history of cervical dysplasia and vaginal warts, previously treated with trichloroacetic acid (TCA). She reported normal health and no health concerns. The physical exam revealed a raised lesion on the perineum, midline, just outside of the introitus. The patient described this as the area of her prior wart. The attending physician recommended placing some acetic acid on the area to evaluate the lesion and, if that showed signs concerning for vulval intra-epithelial neoplasia, they would then discuss performing a biopsy. The patient gave verbal consent for this.

The resident physician asked the medical assistant for acetic acid and unknowingly received TCA. Immediately after the application, the area turned densely white, which was abnormal for acetic acid, and that led to the discovery that TCA had been applied rather than acetic acid. The patient was immediately informed of the error and treated with sodium bicarbonate to neutralize and reverse the effects of the TCA. No TCA appeared to have come in contact with the vaginal mucosa or the labia, and after the sodium bicarbonate treatment the white area was smaller than 0.5 cm. Once the area was completely dry, petroleum jelly and lidocaine ointment were applied for comfort, and the patient was pain-free at discharge. However, one year after the event, the patient continued to complain of discoloration and discomfort.

The Commentary

by Howard I. Maibach, MD

The literature on acute chemical burns is tricky to interpret because of inconsistent nomenclature. This case refers to an acute chemical burn, also known as acute chemical skin injury, and in the dermatologic literature, acute irritation. Often confused with a thermal burn, the mechanisms are distinctly different than heat related and have been studied extensively. Other examples of injuries due to acute acid–base irritation are those caused by topical applications of phenol (in industry and medical peels as well as verruca wart therapy), and those caused by inadvertent intradermal injection of formalin solutions (intended as a local anesthetic).

By the end of World War II, pioneers in occupational dermatology, largely working at the US Public Health Service, had published extensively on acute irritation, outlining interventions to prevent such episodes in the workplace. The recommendations, clearly pertinent to the medical environment, included labeling, safety in shipment, and engineering and education practices to decrease the opportunity for splash and spill. Of particular relevance to this case are the recommendations for large-type labels, packaging in low volumes (to decrease the chance of damage on accidental spill), and the use of a skull and crossbones or other warning signs on labels. These chemicals should be stored in locked cabinets, carefully sequestered from other liquids, and removed, with at least two-way verification, only when utilized by people fully informed in their application. In theory, acute irritation should not occur in the medical environment, nor in the workplace; however, as demonstrated by this case, such injuries continue to occur.

The epidemiology, mechanisms, prevention, decontamination, and treatment of acute chemical burns have been succinctly summarized.(1,2) Estimating the depth of chemical burns can be difficult. A severe, full-thickness burn may appear to be superficial, with only mild discoloration of skin, making it easy to underestimate the magnitude of injury. It may be that the extent of the injury in this case was underestimated because of the small area of visible damage. Long-lasting pain after acute irritation, as occurred in this case, appears to be relatively uncommon. However, it is difficult to evaluate due to the lack of appropriate animal and other models. Recent advances in itch research may offer useful approaches and insights.

Evidence-based treatment is also difficult to define. In chemical burns, skin decontamination is of critical importance because repair cannot proceed until the causative agent is either inactivated by chemical reaction with the tissues or neutralized or removed.(3) Chemical decontamination, as utilized in this case, has long been considered a simple matter, but is actually quite difficult to accomplish. Decontamination has been the subject of extensive investigation by many governments, due to concern about use of chemicals of mass destruction.(2) Recent reviews of decontamination have found that there are no well-controlled comparative studies on the topic.(4,5) This lack of scientific evidence make cases like this one a challenge. Hopefully, a reader of this article will be motivated to fill this gap.

As TCA has been widely used in face peels for almost a century, there are considerable experience-based recommendations that have been developed by practitioners. The most widely used intervention in the TCA chemical peel consists of the application of cold water as a diluent, rather than a neutralizer. The theory behind this intervention is that by the time it is started, the protein denaturation and lipid alterations in the damaged tissue have already occurred. A more extensive database exists on another acid, H2SO4 (sulfuric acid), as a cause of acute irritant dermatitis (1), but this literature also yields equivocal results on the use of water or acid neutralizers. In this particular case, neutralization with sodium bicarbonate was attempted. Immediately flushing the area with cold water may have also been of benefit. The application of petroleum jelly and lidocaine ointment for comfort after the area was dried makes empiric sense, but again lacks specific research evidence.

Given the uncertain state of the evidence regarding neutralization and other maneuvers to avoid skin irritant injuries, the best strategy remains prevention. A few simple steps, such as more effective use of labels and better communication between practitioners, might well have averted this adverse event.

Take-Home Points

- Whenever possible, acute irritant chemicals (TCA, phenol, H2SO4, etc.) should have large-type labels and be packaged in low volume, to decrease the chance of damage on accidental spill, and include the skull and crossbones warning sign.
- These bottles should be stored in locked cabinets, carefully sequestered from other liquids, and removed, with at least two-way verification, only when utilized by people fully informed in their application.
- Until well-controlled and executed studies become available, empiric interventions remain the standard of care. Dilution of the irritant chemical with cold water is generally the first-line treatment, but it is increasingly being questioned.

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