Hand Chemical Burns

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Continuing Medical Education

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Learning Objectives

- Elucidate the pathophysiology of chemical burns.
- Clarify the difference between chemical and thermal burns.
- Discuss the characteristics and mechanism of action of different chemical burns.
- Review the clinical presentation and diagnosis of the most common chemical burns.
- Describe the management options for chemical burns.

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There is a vast and ever-expanding variety of potentially harmful chemicals in the military, industrial, and domestic landscape. Chemical burns make up a small proportion of all skin burns, yet they can cause substantial morbidity and mortality. Additionally, the hand and upper extremity are the most frequently involved parts of the body in chemical burns, and therefore these injuries may lead to severe temporary or permanent loss of function. Despite this fact, discussion of the care of these injuries is sparse in the hand surgery literature. Although most chemical burns require only first response and wound care, some require the attention of a specialist for surgical debridement and, occasionally, skin coverage and reconstruction. Exposure to certain chemicals carries the risk of substantial systemic toxicity and even mortality. Understanding the difference between thermal and chemical burns, as well as special considerations for specific compounds, will improve patient treatment outcomes. *(J Hand Surg Am. 2015;40(3):605–612. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

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Hand burns secondary to chemical exposure make up a diverse set of injuries. They may range from mild erythema to severe tissue loss and even loss of life. The variation depends on the specific characteristics of the agent, the concentration, and duration of exposure.

Chemical burns may occur in the domestic, occupational, or war setting. Each setting presents its own concerns. In the domestic setting there may be a lack of knowledge of the potential harm certain chemicals present and how to perform appropriate first aid. Non-accidental abusive or self-injurious behavior such as attempted suicide may also be involved. The industrial setting has become safer for chemical burns due to increased governmental regulations. Lastly, exposure to chemicals in warfare may be associated with other injuries.

Chemical burns occur most commonly in working-aged individuals.[1] Additionally, the wrist and hand are the most common sites of severe burns.[2] It has also been noted that chemical burns often heal more slowly than thermal burns and require surgery more frequently.[3] When combined, these factors suggest that chemical burns, despite their relative rarity, are a considerable source of economic burden.

Most chemical burns do not result in serious long-term sequelae. Nevertheless, the importance of vigilance and prompt treatment cannot be overstated: Despite only making up 3% of a particular burn center's admissions, chemical burns were responsible for up to 30% of burn-related deaths.[4]

PATHOPHYSIOLOGY

The crucial difference between a chemical burn and a thermal burn is that the damage continues until the chemical is removed or neutralized. Therefore, thorough and prompt decontamination is paramount. Several factors contribute to the characteristic of a burn after chemical exposure.

1. Responsible substance: Chemicals vary in their physical properties and mechanism of action. Although there are many chemicals that may cause burns, we will address only those substances that are important either because of their ubiquity, or because of special considerations involved. For detailed information on any given chemical substance, the U.S. Centers for Disease Control and Prevention (CDC) compiles material safety data, which is readily available on-line. The Agency for Toxic Substances and Disease Registry is a federal public health agency of the U.S. Department of Health and Human Services. Their Web site, administered by the CDC, contains medical management guidelines (available at: http://www.atsdr.cdc.gov/mmg/index.asp).
2. Burn percentage: The risk of systemic toxicity increases with total body surface area (TBSA) affected. Additionally, a larger area of damage may make coverage and reconstruction more difficult.
3. Chemical concentration: Higher concentration leads to more rapid and extensive damage.
4. Time of exposure: The extent of damage is correlated with time of exposure. Early lavage is the most important means of limiting damage.
5. Treatment: Immediate high volume water lavage is the best early management strategy. The use of neutralizing compounds and alternative lavage substances is controversial, but generally discouraged. Certain chemicals have a high risk of systemic toxicity, which requires specific antidotes and supportive measures.
6. Skin properties: The palmar skin has thick stratum corneum, which is more impermeable and therefore resistant to chemical insult than the dorsum. Laceration or breakdown of the resistant epidermis exposes the more sensitive underlying dermis.[1]

DIAGNOSIS

Crucial data in the management of chemical burns are: specific chemical compound and concentration, mechanism of exposure, time of exposure and timeframe of initiation of decontamination. Trauma protocol consisting of focused assessment of airway, breathing, and circulation should be followed. Other areas of exposures such as ocular and inhalational must be ruled out.

Examination of the burn should identify all involved locations. Chemical burns may not show the same early signs of skin damage as thermal burns,[4,5] therefore early grading of burns may be difficult. Serial examination is recommended. An estimation of TBSA involved will guide fluid resuscitation and other treatment measures. Systemic complications are ruled out by obtaining early electrocardiography and electrolyte analysis.

INITIAL TREATMENT

Initial treatment involves decontamination, and must begin immediately after chemical exposure. Industrial settings are mandated to have procedures in place and high-flow rinsing stations. Evidence indicates that when treatment is initiated "in the field", outcomes