

Phenol Burn

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Introduction

Skin burn can result from contact with chemicals, electricity, radiation, or hot objects. Occupation, geographic location, and season of the year, are among important factors to be considered to assess the risk of burn. Although chemical burns resemble thermal burns, in chemical burns one may suffer from the toxicity too. The severity of the injury depends on the contact duration, type of chemical, and contamination method. One of the caustic agents commonly used in industries is phenol. Knowing the mechanism of injury and emergency management of various routes of exposure will facilitate the right therapy and achieve a better outcome.

In different countries and industries, phenol is named differently. Alternative names for phenol are benzenol, carboic acid, hydroxybenzene, monohydroxybenzene, monophenol, oxybenzene, phenic acid, phenolum, phenyl alcohol, phenyl hydrate, phenyl hydroxide, phenylic acid, and phenylic alcohol. Phenol is commonly used in the manufacture of phenolic resins, bisphenol A, caprolactam, and alkyl phenols. It is also used in dye industries, as an antiseptic agent and disinfectant, and as a preservative in making pharmaceutical drugs. Phenol is also used in making explosives, paint removers, rubber, fertilizers, asbestos products, wood preservatives, synthetic resins, textiles, perfumes, and plastics.

Phenol is a strong caustic agent. After contact with skin, it causes discoloration of the skin. Phenol can penetrate the skin rapidly causing a severe chemical burn. However, because of its analgesic properties,¹ it will cause painless burning on its initial contact.^{2,3} Contact with dilute phenol may induce dark pigmentation on the skin. After a prolonged contact, dilute phenol solutions (1%–2%) may even cause severe burns.

With an absorption efficiency of almost equal to that of inhalation, phenol is rapidly absorbed through the skin, causing systemic toxicity. In one case, death occurred within 30 minutes after contact with the skin. Systemic toxicity may result from phenol vapor^{2,4} and can be presented with nausea, vomiting, diarrhea, methemoglobinemia, hemolytic anemia, profuse sweating, hypotension, arrhythmia, pulmonary edema, and tachycardia. Symptoms may be delayed for up to 18 hours of exposure.⁴ Children are more prone to develop toxicity since they have a relatively larger body surface area to body weight ratio.⁴

When phenol comes into contact with skin, a white covering of precipitated protein is formed. This soon turns red and eventually sloughs, leaving the surface stained slightly brown. If phenol is left on the skin, it will penetrate rapidly and cause deep burns and elicit denaturation and gangrene followed by tissue necrosis. If more than 400 cm² of skin are affected,

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there is risk of imminent death.⁴

First Aid Measures

The first priority in taking care of a burnt person with phenol in the scene is protecting the care giver by putting on disposable gloves and wearing goggles. Assess the patient for inhalation injuries; if he or she has major burn he or she must be given 100% humidified oxygen by face mask. If patient has no breath, never give him mouth-to-mouth respiration. Stop the burn process by removing the chemicals at once; if possible, brush the phenol off the skin. Pay attention not to brush it into patient's eyes and not to contaminate the skin that has not been contaminated. Contaminated cloths and shoes must be removed and taken away. Jewels, rings and watches must be removed and put in a double-bag, labeled as biohazard and kept in a sealed container. In case of direct skin contact, a solvent cleaner with both hydrophilic and hydrophobic properties may be used for decontamination and removal of phenol from the skin, if available.⁵⁻⁷ Wash the skin with copious amounts of water for at least 30 minutes. Do not rub or wipe the affected areas as this would aggravate irritation and cause dispersion of phenol. Continue the therapy until the burnt area changes color from white to pink. If the burning sensation increases after the initial washing, rewash the area for a few more minutes. At first, clean and wash the open injuries (and, consider hypothermia). If solvents such as isopropanol or glycol or polyethylene glycol are available, use them for decontamination. Castor oil, baby oil or any oily substances can be used as well. In case of eye contact, irrigate the eye with copious amounts of water or normal saline. To help reduce the pain, apply cool wet gauze to the skin. Cover up the affected

area and wrap it loosely with a dry, sterile dressing or a clean cloth. Repeatedly apply polyethylene glycol to the affected area.^{2,7} It should be done during transportation to the hospital. If polyethylene glycol is not available, you may flush the area with water for at least 30 minutes since in animal models polyethylene glycol has not been shown to be more effective than irrigation with large amounts of water.²

Patients are usually alert and awake but in case of systemic involvement, mental status may be influenced. So paramedics should have concerns about hypotension, hypothermia, and pulmonary edema. Give patient nothing per oral. Insert a nasogastric tube, especially in those with burn of more than 20% of body area. Start intravenous fluid, dress the wounds and cover the patient with a clean blanket and transfer him/her to a burn center or an emergency department.

Emergency Department Management

When a patient arrives in a burn center or an emergency department, his or her general conditions including airway patency, breathing, circulation and mental status should be assessed. To remove any remaining phenol on the skin, polyethylene glycol and isopropyl alcohol should be used. However, in those patients with skin damages, use of isopropyl alcohol—for its irritant nature—is not recommended. Dilute polyethylene glycol in water and make a 50/50 (v/v) solution; then use it to clean the skin. Minor chemical burns need no interventions; they will be healing within few day. But, if there is a second- or third-degree burn or if systemic manifestations occurred, then medical interventions are very important. Further treatment in chemical burn is similar to that of thermal

TAKE-HOME MESSAGE

- In chemical burns, wound is not the most obvious injury.
- Phenol may cause serious painless burns since it is a local anesthetic.
- If patient has no breath, never give him mouth-to-mouth resuscitation.
- To remove any remaining phenol on the skin, polyethylene glycol and isopropyl alcohol should be used.
- Wash the skin with copious amounts of water for at least 30 minutes.

burns. In the emergency department, patient must be exposed in a warm place with no air turbulence to evaluate the size and depth of the burn. To control the pain, if any, narcotics may be administered. Intravenous infusion of fluids, preferably Ringer's lactate solution, should be started. The priorities on giving care are based on the associated life-threatening injuries. Remember that in chemical burns, wound is not the most obvious injury.

In a recent study, all of the wounds had good response to application of silver sulfadiazine ointment and healed completely 10–14 days after the burn. The wounds were all uneventful at regular follow-up except for uneven hypo- and hyper-pigmentation over the burnt areas with small hypertrophy scars.^{7,8}

Safety Measures

To prevent contamination, containers of phenol should be protected against physical damage and stored in cool, dry, and well-ventilated locations where the

fire hazard is low. Chemical goggles, a self-contained breathing apparatus, rubber gloves, an apron, and boots should be worn to reduce the potential injury from phenol. To prevent skin contact, wear imperceptible protective clothing, including boots, gloves, lab coat, apron or coveralls, depending on the situation.⁷ Butyl rubber and neoprene are suitable materials for personal protective equipment.² All phenol workers should be properly informed of and trained about its hazards and the necessary appropriate protective measures. The provided information should also include emergency actions. All phenol operations should be enclosed to eliminate any potential exposure routes. Containers of phenol may also be hazardous when empty since the containers retain phenol residues (vapors, liquid); observe all warnings and precautions listed for the product.²

Conflict of Interest: None declared

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Faravahar or *Farohar* is one of the best-known symbols of ancient Iran. The symbol in this figure is made from tile. For an article on lead poisoning among traditional tile workers in Iran see page 29.