Topical Chemical Burn

Aliases

Chemical Burn

Patient Care Goals

1. Rapid recognition of a topical chemical burn
2. Initiation of emergent and appropriate intervention and patient transport

Patient Presentation

Inclusion Criteria

1. Patients of all ages who have sustained exposure to a chemical that can cause a topical chemical burn may develop immediate or in some cases a delayed clinical presentation.
2. Agents that are known to cause chemical burns include alkali, acids, mustard agent, and lewisite.

Exclusion criteria

None recommended

Patient Management

1. Don the appropriate PPE; ensure rescuers are properly trained and equipped.
2. Remove the patient's clothing, if necessary.
3. Place contaminated clothing in double bags.
4. Transport patient by EMS providers if deemed necessary and manpower resources permit. The EMS providers should be those who did not participate in the decontamination process, and transport should occur in an emergency response vehicle that has not been exposed to the chemical.
5. Gather information regarding the chemical while on scene, including materials safety data sheet if available.
6. Communicate all data regarding the chemical to the receiving facility.

Assessment

1. Be aware that clinical effects and severity of a topical chemical burn is dependent upon:
    a. Class of agent (alkali injury or acid injury).
    b. Concentration of the chemical the (higher the concentration, the greater the risk of injury).
    c. pH of the chemical:
        i. Alkali-increased risk with pH greater than or equal to 11
        ii. Acid-increased risk with pH less than or equal to 3
    d. Onset of burn
        i. Immediate
        ii. Delayed (e.g. hydrofluoric acid)
2. Calculate the estimated total body surface area that is involved.
3. Prevent further contamination.
4. Provide special attention to assessment of ocular or oropharyngeal exposure; evaluate for airway compromise secondary to spasm or direct injury associated with oropharyngeal burns.
5. Recognize that some acid and alkali agents may manifest systemic effects.

Treatment and Interventions

1. If dry chemical contamination, carefully brush off solid chemical prior to flushing the site as the irrigating solution may activate a chemical reaction.
2. If wet chemical contamination, flush the patient's skin (and eyes, if involved) with copious amounts of water or normal saline.
3. Provide adequate analgesia per the Pain Management guideline.

4. Consider the use of topical anesthetic eye drops (tetracaine, **[PARA]**)for chemical burns of the eye.
5. For eye exposure, administer continuous flushing of irrigation fluid to eye with tap water, sterile water, saline. May be via bottles, IV bags, modified nasal canula, IV tubing.
    - Be sure to irrigate away from unaffected eye
    - If high flow eye irrigation is available on scene and no other condition require immediate transport, eye irrigation for approximately 20 minutes should occur prior to transport
6. Administer early airway intervention for airway compromise or spasm associated with oropharyngeal burns.
7. Take measures to minimize hypothermia.
8. Consider isotonic IV/IO fluid bolus 20 ml/kg ***[AEMT]***

Hydrofluoric Acid

- Hydrofluoric acid (HF) is a highly corrosive substance that is primarily used for automotive cleaning products, rust removal, porcelain cleaners, etching glass, cleaning cement or brick, or as a pickling agent to remove impurities from various forms of steel. Hydrofluoric acid readily penetrates intact skin and there may be underlying tissue injury. It is unlikely that low concentration HF will cause an immediate acid-like burn, however there may be delayed onset of pain to the exposed area. Higher concentration HF may cause immediate pain as well as more of a burn appearance that can range from mild erythema to an obvious burn. An oral or large dermal exposure can result in significant systemic hypocalcemia with possible QT prolongation and cardiovascular collapse.

1. For all patients in whom a hydrofluoric acid exposure is confirmed or suspected:
    a. Vigorously irrigate all affected areas with water or normal saline for a minimum of 15 minutes.
    b. Apply ECG cardiac monitor for oral or large dermal exposures significant HF exposures.
    c. Apply **calcium** preparation:
        i. Calcium prevents tissue damage from hydrofluoric acid.
        ii. Topical calcium preparations:
            1. Commercially manufactured calcium gluconate gel
                a. Commercial locations using hydrofluoric acid often have topical calcium gluconate gel onsite
            2. If commercially manufactured **Calcium Gluconate gel [PARA]** is not available, a topical calcium gluconate gel preparation can be made by combining 150 mL (5 ounces) of a sterile water-soluble gel (e.g. Surgilube® or KY®jelly) with one of the following:
                a. 35 mL of calcium gluconate 10% solution
                b. 10 g of calcium gluconate tablets (e.g. Tums®)
                c. 3.5 g calcium gluconate powder or
            3. If calcium gluconate is not available, 10 mL of **Calcium Chloride** 10% solution in 150 mL in sterile water soluble gel (e.g. Surgilube® or KY® jelly) ***[PARA]*** :
            4. Apply generous amounts of the calcium gluconate gel to the exposed skin sites to neutralize the pain of the hydrofluoric acid.
                a. Leave the gel in place for at least 20 minutes then reassess.
                b. This can be repeated as needed.
            5. Although generally low yield, there may be benefit to intravenous pain medication along with the topical calcium gluconate gel for pain control.
            6. If fingers are involved, apply the calcium gel to the hand: Squirt additional calcium gel into a surgical glove, and then insert the affected hand into the glove.
            7. For patients who have ingested hydrofluoric acid or who have a large dermal exposure, consider intravenous calcium gluconate as symptomatic hypocalcemia can precipitate rapidly as manifest by muscle spasms,

seizures, hypotension ventricular arrhythmias and QT prolongation.

Patient Safety Considerations

1. Don PPE.
2. Take measures to prevent the patient from further contamination through decontamination.
3. Take measures to protect the EMS provider and others from contamination.
4. Do not attempt to neutralize an acid with an alkali or an alkali with an acid as an exothermic reaction will occur and cause serious thermal injury to the patient.
5. Consider expeditious transport or transfer to a designated burn center for burns that involve a significant percentage of total body surface area or burns that involve the eyes, face, hands, feet or genitals.

Notes and Educational Pearls Key Considerations

- IV fluid resuscitation should be guided by patient age and clinical status.
- Since the severity of topical chemical burns is largely dependent upon the type, concentration, and pH of the chemical involved as well as the body site and surface area involved, it is imperative to obtain as much information as possible while on scene about the chemical substance by which the patient was exposed. The information gathering process will often include:
    - Transport of the "sealed" container of the chemical to the receiving facility.
    - Transport of the original or a copy of the Material Safety Data Sheet (MSDS) of the substance to the receiving facility.
    - Contacting the reference agency to identify the chemical agent and assist in management (e.g. CHEMTREC®).
- Inhalation of HF should be considered in any dermal exposure involving the face and neck or if clothing is soaked in the product.
- Decontamination is critical for both acid and alkali agents to reduce injury. Removal of chemicals with a low pH (acids) is more easily accomplished than chemicals with a high pH (alkalis) because alkalis tend to penetrate and bind to deeper tissues.
- Some chemicals will also manifest local and systemic signs, symptoms, and bodily damage.

Pertinent Assessment Findings

- An estimate of the total body surface area that is involved
- Patient response to therapeutic interventions
- Patient response to fluid resuscitation
- Patient response to analgesia

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914213—Injury-Topical Chemical Burn

Key Documentation Elements

- Burn site
- Body surface area involved
- Identification of the chemical
- Reported or measured pH of the chemical
- Acquisition and transfer of MSDS, chemical container, or other pertinent substance information to the receiving the facility

Performance Measures

- Accurate (overtriage or undertriage) triage of patients to designated burn centers
- Early recognition of a topical chemical burn with appropriate treatment

- Early recognition of hydrofluoric acid burns followed by expeditious initiation of treatment with calcium gluconate and/or calcium chloride and appropriate analgesia
- Measures taken to prevent further contamination

References

1. American Heart Association. *Advanced Pediatric Life Support. Jones & Bartlett Learning LLC;* 2013.
2. Ferng M, Gupta R, Bryant SM. Hazardous Brick Cleaning. *J Emergency Medicine.* 2009;37(3):305-7.
3. Hoffman RS, Howland MA, Lewin NA, Nelson LS, Goldfrank LR. *Goldfrank's Toxicologic Emergencies, 10th Edition*. China: McGraw-Hill Education; 2015.
4. Marx JA et al. *Rosen's Emergency Medicine: Concepts and Clinical Practice*, 2010 769- 770
5. O'Sullivan SB, Schmitz TJ. *Physical Rehabilitation*, 5th Edition. F.A. Davis; 2007: 1098.
6. *Recommended Medical Treatment for hydrofluoric Acid Exposure.* Morristown, NJ: Honeywell Performance Materials and Technologies; October 2012.
7. Tintinalli JE, ed. *Tintinalli's Emergency Medicine, 7th Edition*. McGraw-Hill Education; 2011: 1297, 1351, 1381 1382.