Objectives

- List 3 major classes of potentially injurious chemicals and their mechanisms of action
- Outline initial management
- List factors contributing to injury severity
- Identify & describe treatment for special chemical burns (hydrofluoric acid, phenol, petroleum exposure)
- Describe initial treatment of chemical eye injuries
- Identify commonly used chemical warfare agents
Introduction

- 500,000 + chemicals in use in U.S.
- 30,000 designated as hazardous
- 60,000 seek medical care annually for chemical burns
Injury extent related to interval between injury & institution of appropriate medical therapy

Initial appearance may be deceptive

Refer to burn center
Classification

Most common

- **Alkalis** → Home & work: cleaning, hobbies
- **Acids**
- **Organic compounds** -- petroleum products
Alkalis

- Hydroxides, carbonates, caustic sodas of sodium, potassium, ammonium, lithium, barium, calcium

- Oven cleaners, drain cleaners, fertilizers, industrial cleaners

- Structural bond for cement, concrete (pH wet cement = 12)

- Tissue damage by liquefaction necrosis & protein denaturation
Classication

Acids

- Common household items
- Hydrochloric acid in many bathroom cleansers
- Oxalic & hydrofluoric acids common in rust removers
- Concentrated hydrochloric & muriatic acid for pools
- Concentrated sulfuric acid in drain cleaners
- Tissue damage by coagulation necrosis & protein precipitation
Organic Compounds

- Phenols -- chemical disinfectants
- Petroleum -- creosote, gasoline
- Cutaneous damage due to fat solvent action (cell membrane solvent action)
- Systemically absorbed: toxic effects on kidneys and liver
Severity of injury related to

♦ Agent
♦ Concentration (depth of injury)
♦ Volume (extent of BSA involved)
♦ Duration of contact
♦ Mechanism of action of the agent
♦ Immediate irrigation, decreased concentration and duration of contact
♦ Delay in treatment permits continued tissue damage
Treatment

Universal Precautions

♦ Gloves, gown, eye protection prior to patient contact
♦ Caution with patient clothing and belongings
♦ Failure to follow simple precautions may lead to significant provider injury
- Remove saturated clothing
- Brush off powder agents
- Continuously irrigate area with copious amounts of water

- Neutralizing chemical contraindicated; potential of heat generation
- Continue irrigation until pain decreases or until patient is evaluated at a burn center
Support ABCs

Chemical agents can impact respiratory &/or circulatory status

Establish IV access for significant chemical injuries

Identify agent if possible

Do not delay therapy until agent is identified

Contact Poison Control Center if needed
Chemical Injuries to Eyes

- Alkalis twice as common as acid injuries
- Alkalis bond to tissue proteins: require prolonged irrigation

- Water or saline irrigation
- Begin irrigation at scene and continue
- Consult ophthalmologist
Chemical Injuries to Eyes

- Present with swelling &/or spasm of lids
- Irrigation is essential

- Place catheters in medial sulcus & irrigate continuously with saline
- Topical ophthalmic anesthetics may be useful
- Allows for prolonged irrigation with runoff away from other eye

- Irrigating catheter lens may be fitted over globe
  - Use with caution to prevent eye injury
- Continue irrigation until patient is evaluated
Hydrofluoric Acid

- **Industrial Use**
  - Etch glass
  - Teflon
  - Clean semiconductors

- **Home Use**
  - Rust remover

- Weak acid, but fluoride ion very toxic
- Severe pain for 6 – 18 hrs
- Tissue necrosis
- Hypo-calcemia as fluoride binds free serum calcium
Hydrofluoric Acid

- Flood wound with water
- Neutralize with topical calcium gel
  - 1 amp calcium gluconate in 100 gm lubricating jelly
  - Apply with gloved hand
- High concentrations may be life threatening
- Cardiac monitoring
- IV line for treatment of hypocalcemia
- Wound excision may be required
- Burn center consultation

- Rare patients may require intra-arterial calcium infusion or subeschar dilute calcium gluconate
Phenol

- Acidic alcohol with poor water solubility
- Disinfectants, chemical solvents
- Coagulation necrosis of dermal proteins

- Copious water irrigation
- Cleansing with 30% polyethylene glycol or ethyl alcohol
- Diluted solutions of phenol penetrate skin more rapidly
Petroleum Injuries

♦ Gasoline & diesel fuel
♦ Tissue injury by delipidation
♦ Full-thickness skin damage
♦ Often in motor vehicle crashes
  • May be overlooked
  • Check back, buttocks, and lower extremities
♦ Systemic toxicity seen 6 – 24 hours post exposure
♦ Hepatic enzyme elevation
♦ ↓ UOP
♦ Possible lead toxicity
Tar Burns

- Thermal, not chemical
- Bitumen compound not absorbed, not toxic
- Cool tar to stop the burning process
- Facilitate removal with emulsification of tar by petrolatum-based ointment or medically safe solvents
Anhydrous Ammonia

- Fertilizer or industrial refrigerant
- Manufacture of methamphetamine
- Strong base with penetrating odor
- Skin blistering with exposure
- Lung injury if fumes inhaled

- Copious water irrigation
- Inhalation injury, hypoxemia, copious secretions may need ventilator support
World War I to Modern Day Terrorist Attacks

Categories
- Vesicants--mustard agents, Lewisite
- Nerve agents--Sarin
- White Phosphorus--keep particles & affected area soaked in water, wet dressings to avoid ignition
Chemical Warfare

- Treatment regimen as for other agents
  - Consider cutaneous & systemic toxicity and pulmonary, hepatic, neurological damage
- If there are multiple patients, you need to isolate clothing and items containing injurious chemical to prevent provider injury or environmental exposure
Chemical burns constitute a special group of injuries

Referral to burn center is recommended

Ensure provider safety

Immediate removal of agent followed by copious amounts of water irrigation

Phenol, petroleum, hydrofluoric acid require special consideration

Eye injuries require ophthalmologist exam