Project: Ghana Emergency Medicine Collaborative

Document Title: Environmental Emergencies

Author(s): Patrick Carter (University of Michigan), MD 2012

Attribution Key

for more information see: http://open.umich.edu/wiki/AttributionPolicy

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

Public Domain – Government: Works that are produced by the U.S. Government. (17 USC § 105)

Public Domain – Expired: Works that are no longer protected due to an expired copyright term.

Public Domain – Self Dedicated: Works that a copyright holder has dedicated to the public domain.

Creative Commons – Zero Waiver

Creative Commons – Attribution License

Creative Commons – Attribution Share Alike License

Creative Commons – Attribution Noncommercial License

Creative Commons – Attribution Noncommercial Share Alike License

GNU – Free Documentation License

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

Public Domain – Ineligible: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }

Fair Use: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.

Objectives

- Electrical and Lightening Injuries
- Tetanus
- Heat Illnesses
- Burns

ELECTRICAL INJURIES

Electrical Injuries

- Definitions
  - Electrical Injuries
    - Alternating Current Injuries
    - Direct Current Injuries
- Voltage definition
  - Low Voltage < 1000 Volts
  - High Voltage > 1000 Volts

Scott Ehardt, Wikimedia Commons

PD-SELF

AC vs. DC Current

AC

Household Current

DC

Batteries
Railroad Tracks
Car Electric Systems
Lightning

AC vs. DC

- <u>Alternating Current</u>
  - Requires lower energy to cause damage
  - Findings:
    - Tetany
    - Resp Paralysis
    - Burns
  - Large Exit wounds
  - Ventricular tachycardia
- <u>Direct Current</u>
  - Single muscle spasm that throws victim from source
  - Decreased exposure but more blunt trauma
  - Smaller exit wounds
  - Asystole

AC: Low vs. High Voltage

- Low-voltage (<1000 V)
  - Can have with cardiac/respiratory arrest
  - Prompt BLS, can fully recover.
- High-voltage injury (>1000 V)
  - Don't tend to arrest
  - Burns
  - Myoglobinuria

Factors leading to Severe Injury

- Higher voltage (> 1000 Volts)
- Current intensity
- Alternating current
- Resistance of tissue
- Duration of contact
- Current pathway (hand-hand vs. head-toe)

Pathophysiologic effects of different intensities of electrical current

Current intensity	Effect
1 mA	Tingling sensation; almost not perceptible
3-5 mA	"Let-go" current for an average child
6-9 mA	"Let-go" current for an average adult
16 mA	Maximum current a person can grasp and "let go"
16-20 mA	Tetany of skeletal muscles
20-50 mA	Paralysis of respiratory muscles; respiratory arrest
50-100 mA	Threshold for ventricular fibrillation
>2 A	Asystole
15-30 A	Common household circuit breakers
240 A	Maximal intensity of household current (U.S.)

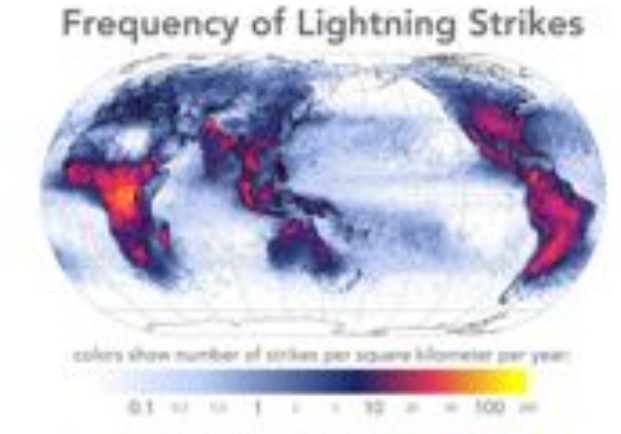
 Koumbourlis, AC. Electrical Injuries. Crit Car Med 2002; 30:S425

LIGHTNING INJURIES

Lightning Injuries

- Most Patients Die instantly
  - Asystole
  - Respiratory Center
- If alive, can have associated blunt injuries as well from being thrown
- Patients will need admission
  - Cardiac monitoring (arrhythmias)
  - Renal function monitoring

PeWu, Flickr



Citynoise, Wikimedia Commons

Lichtenberg Burn

Laboratory Evaluation

- ECG
- CBC
- Electrolytes
- Creatinine
- CK
- UA
- Myoglobin

Management

- Stabilization and Fluid Resuscitation
- In CNS abnormality, avoid over-hydration and subsequent cerebral edema.
- Mannitol or furosemide for patients with elevated CK/ myoglobinemia. Avoid ATN
- Lightening: CNS symptoms. If GCS =15 on arrival w/ no symptoms of impaired renal fxn & if CK is not > 2x normal, consider OBS & DC.
- Irregularities of pulse, ECG changes, myoglobinuria, or CNS abnormalities require hospitalization.

Admission Criteria

- High Voltage (>1000 V)
- Low Voltage with
  - Conductive flow through head, chest or abd
  - Pts with chest pain, abdominal pain, confusion
  - Digit involvement with possible neurovascular compromise
  - Abnormal EKG, or suspected dysrhythmia
  - Abnormal UA

Pediatric Considerations

- Electrical Cord
  - If bite through cord, oral involvement
  - 3-14days after pts can have labial artery bleed

PD-INEL Source Undetermined

TETANUS

Tetanus

Sir Charles Bell, 1809, Wikimedia Commons

PD-EXP

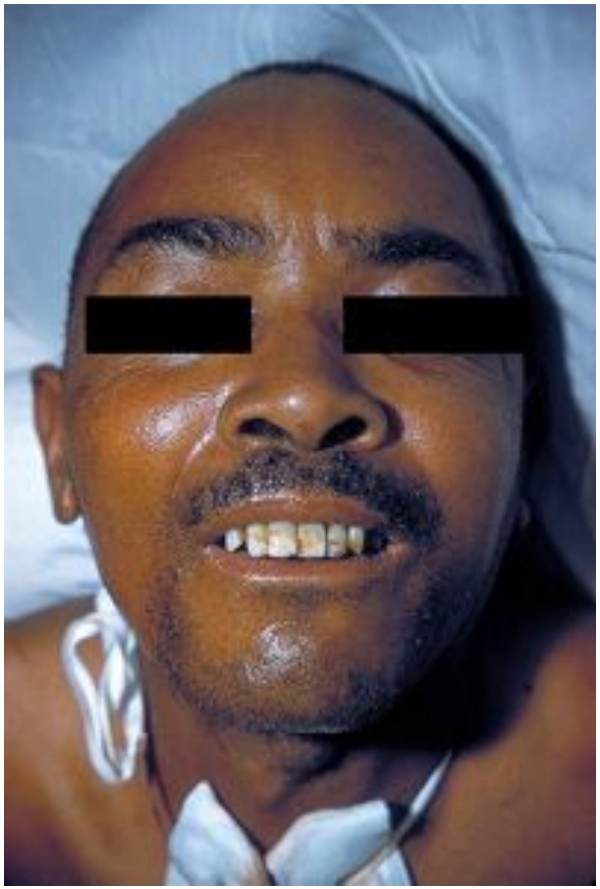
- C. tetani produces exotoxin that is the causative agent of Tetanus
- Tetanus: 4 forms
  - Localized Tetanus - muscle rigidity at or near site
  - Generalized Tetanus - most common, tetany of fist, sweating, tachycardia, significant mortality
  - Cephalic Tetanus - dysfunction of cranial nerves
  - Neonatal Tetanus - inadequate maternal immunization, high mortality

Tetanus

- Prophylaxis
  - Clean Wound
    - Recent immunization (does not need booster)
    - No recent immunization (needs Td)
    - If never immunized pt needs Tetanus immunoglobulin (TIG and Td)
  - Dirty Wound = crush injury, saliva, burns
    - Recent immunization (needs Td)
    - No recent immunization (needs TIG and Td)

Tetanus

- Treatment
  - ABC's
  - Clean contaminated wound
  - Muscle relaxants
  - Neuromuscular Blockade
  - Labetalol
  - Clonidine



Center for Disease Control, Wikimedia Commons

PD-GOV

Center for Disease Control, Wikimedia Commons

PD-GOV

HEAT ILLNESS

Heat illness

- Heat Gain
  - Metabolism heats up body 1.1 degree per hour
  - Environmental sources
- Heat loss
  - Convection - heat release from body to air and water vapor
  - Conduction - contact with cooler object
  - Evaporation - transform sweat and saliva to vapor
  - Radiation - heat transfer to air, vasodilatation, if temp higher then we gain heat
- At Risk Patients
  - Extremes of age
  - Medical illness (DT's, hyperthyroid, Parkinson's)
  - Dehydrated
  - Drugs- Amphetamines, Cocaine, ETOH, Anticholinergic

Heat Exhaustion

- Mild to Moderate dysfunction of temp control
- Symptoms similar to viral illness
  - Nausea, vomiting, cramps, headache, weakness
- Temp < 41 degrees
- Labs: Electrolytes, BUN/CR and liver function tests
- Treatment
  - Passive cooling, cool IVF

Heat Stroke

- Temp > 40.5 degrees
- Same symptoms of exhaustion but addition of neurologic involvement
  - Altered Mental Status, Hallucinations, Ataxia, Seizures
- Physical Exam
  - Altered Mental Status
  - Tachycardia- arrhythmias resistant to Cardioversion
  - Tachypnea

Heat Stroke

- Labs
  - Coagulopathy
  - Elevated Liver Enzymes
  - Hematuria
  - Elevated CK
- Treatment
  - Ice packs in groin and axilla
  - Cold gastric lavage
  - Peritoneal lavage
  - Control shivering with benzodiazepines
- Monitor
  - Cardiac monitoring
  - Hold on acetaminophen as it can worsen liver dysfunction

BURNS

Epidemiology of Burns

- 1-1.5% of population sees MD for burns/year in US
- 1.25-2.5 million burns each year
- 500,000 ED visits, 50,000 admits,5,000 deaths
- Most burns cover less than 5-10% of body surface area
- Types of Burns
  - Thermal
  - Chemical
  - Electrical

Thermal Burns

- Contact
- Flame
- Heat
- Scalding

Chemical Burns

- Both acids and bases can be defined as caustics, which cause significant tissue damage on contact.
- ACIDS produce a coagulation necrosis by denaturing proteins, forming a coagulum (e.g. eschar) that limits the penetration of the acid.
- BASES typically produce a more severe injury known as liquefaction necrosis

Chemical Burns

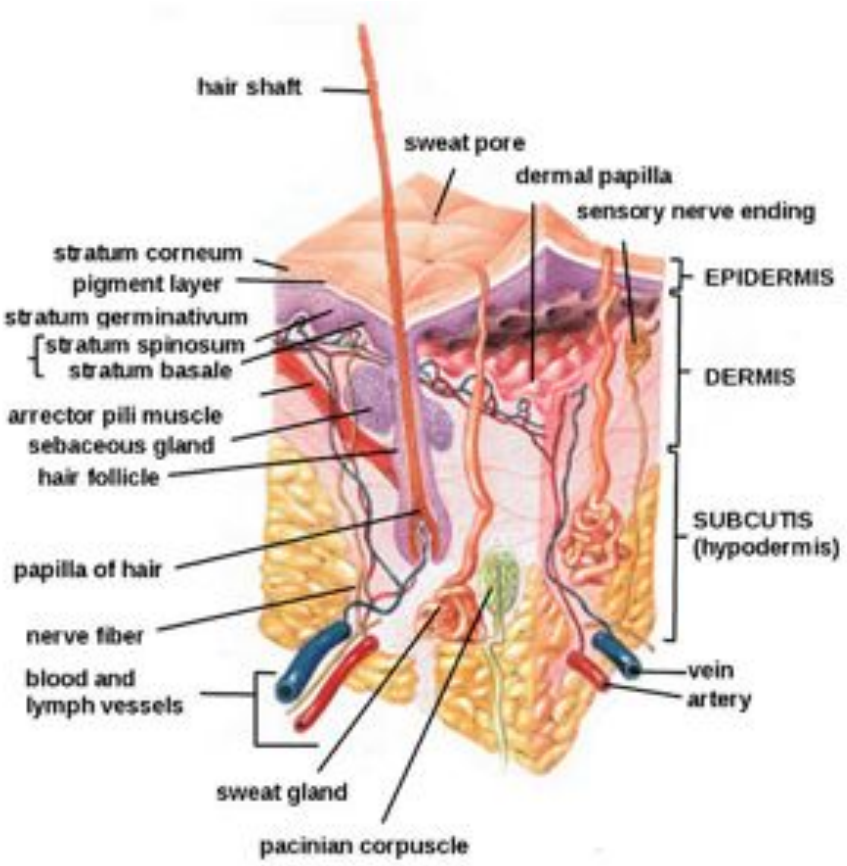
- Acids
  - Toilet bowl cleaners, drain cleaners, metal cleaners, automobile battery fluid, fertilizer manufacturing, rust removers, tire cleaners, tile cleaners, glass etching, dental work, refrigerant, and hair wave neutralizers
- Bases
  - Drain cleaners, bleach, oven cleaners, mortar, plaster, and cement

Electrical Burns

- Low-voltage
  - Electric burns almost exclusively involve either the hands or oral cavity.
- High-voltage
  - In burns from an electric arc, the current courses external to the body from the contact point to the ground
  - Electric current that passes between the power source and the anatomic point of contact (entrance wound), and between the patient (exit wound) and the grounding mechanism, causing hidden destruction of deeper tissues

General Skin Anatomy

- Skin Layers
  - Epidermis
  - Dermis
- Skin Function
  - Protection
    - Pathogens
    - Water loss
  - Temp regulation
  - Sensation
  - Vitamin D Synthesis

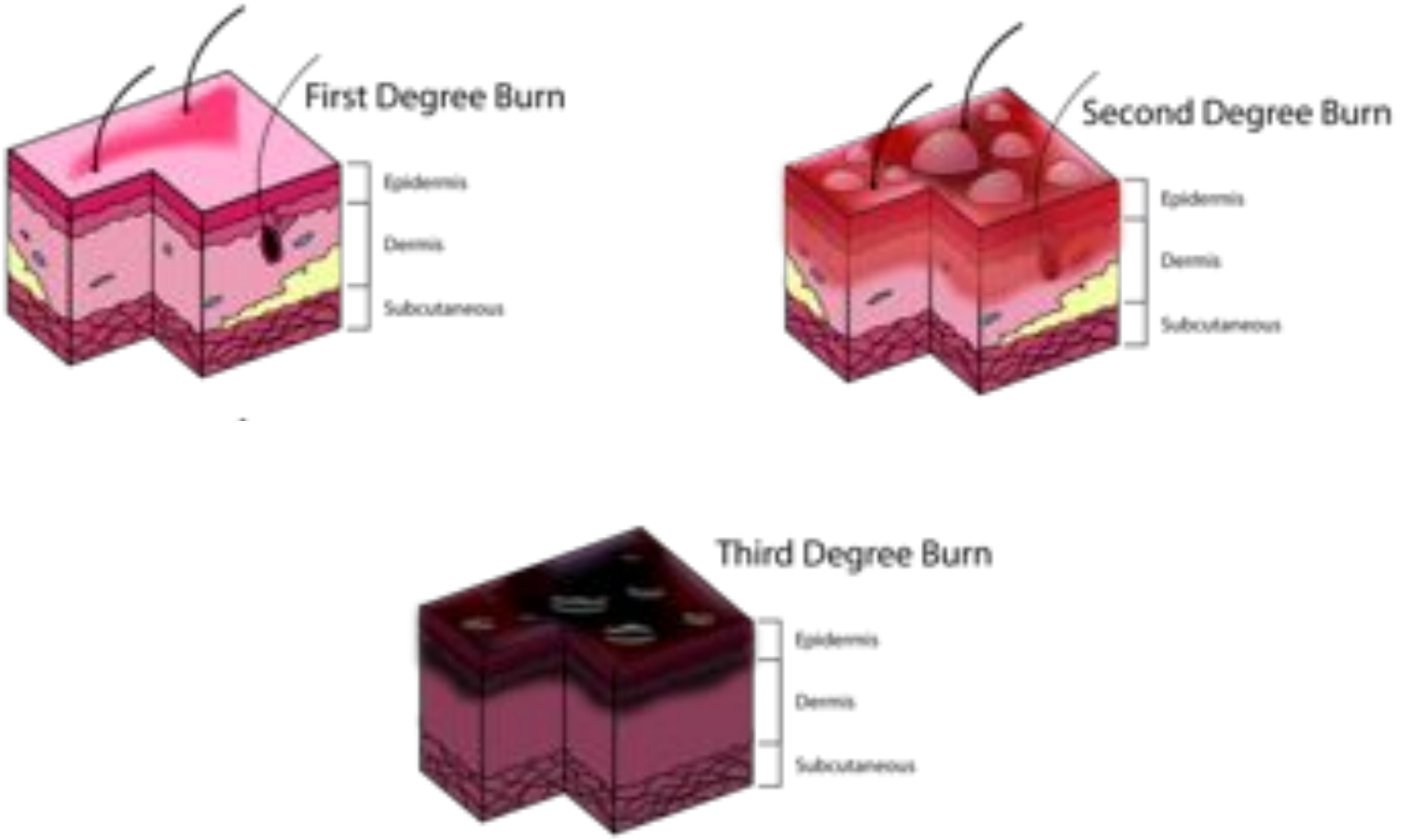


Daniel de Souza Telles, Wikimedia Commons

Burn Classification

- Traditional Classification
  - 1st degree
  - 2nd degree
  - 3rd degree
- Current Classification
  - Superficial partial thickness
  - Deep partial thickness
  - Full Thickness

Burn Classification



K. Aainsqatsi, Wikimedia Commons

Superficial Burn

- Redness
- Dry skin
- Painful to touch
- Pain lasts 48 to 72hrs
- Peeling skin

QuinnHK, Wikimedia Commons

PD-SELF

Partial Thickness Burn

- Involves the top layers of skin
- The skin is red and blistered
- Usually painful
- Takes up to 3-4 weeks to heal.
- May have scar formation

Westchaser, Wikimedia Commons

PD-SELF

Full Thickness Burns

- Destroys all layers of skin and underlying structures
- Appears brown or black
- Underlying tissue may be white
- Usually not painful

Craig0927, Wikimedia Commons
PD-SELF

Pathophysiology of Burns

- Cellular damage at >45° C
- Dependent on temperature and duration
  - Singer et al. Acad Emerg Med 2000;7:1
- Three zones of injury –
  - Central zone of necrosis
  - Zone of stasis (at risk of necrosis)
  - Zone of hyperemia
  - Jackson Br J Surg 1953;40:588 Burn Pathophysiology

Pathophysiology of Burns

- Thermal injury triggers intense inflammatory response
  - Initial release of histamine, bradykinin
  - Increased capillary permeability with third spacing
  - Progressive vascular occlusion by PMN, RBCs
  - Release of free radicals, proteases

Clinical Evaluation

- History
  - History of events
    - Closed space, toxic fumes
  - Evaluate for inconsistencies or patterns suggesting child abuse
    - E.g. Immersion injuries
  - Past Medical History:
    - AMPLE
    - Tetanus immunization status

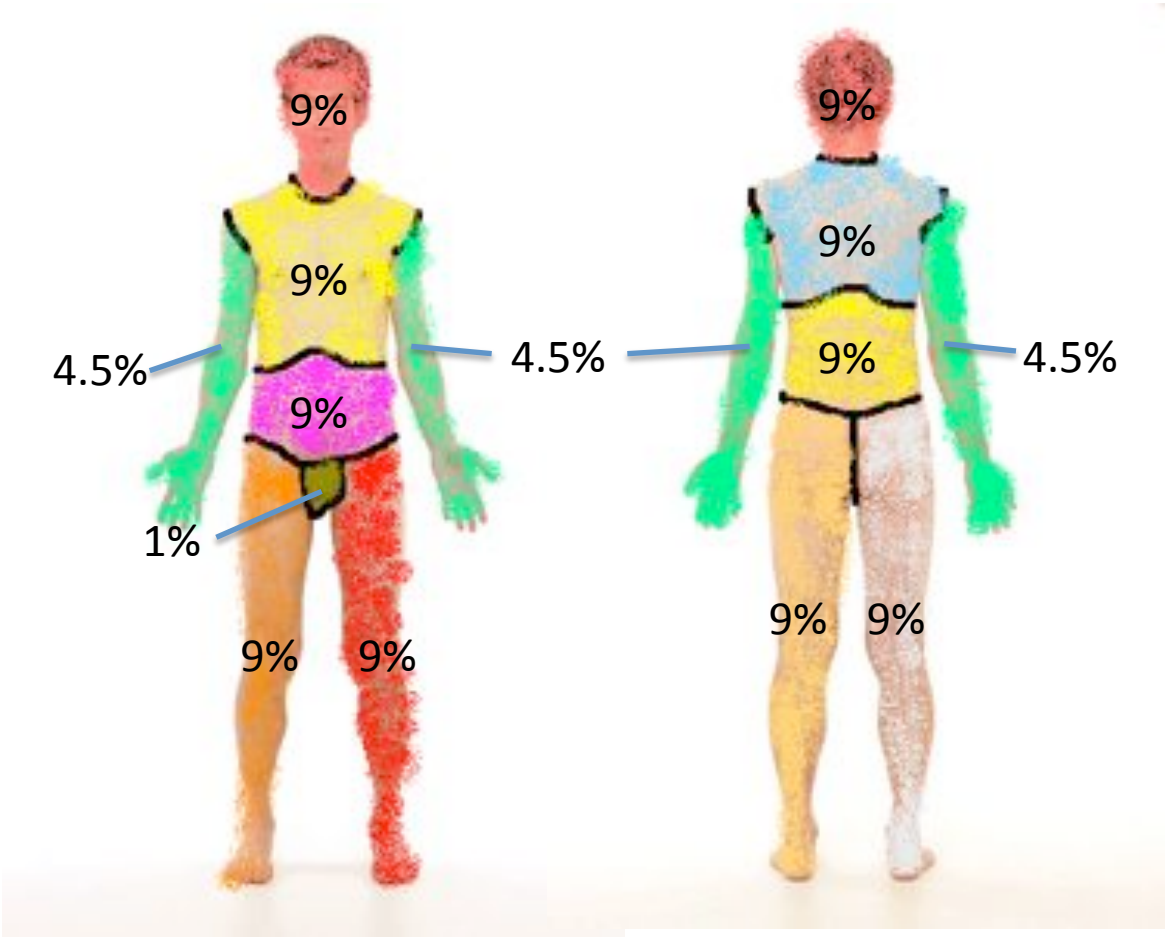
Clinical Evaluation

- Physical Exam
  - Assess for inhalation injury
    - » Signs not always present
    - Singed nasal hair
    - Carbonaceous sputum
    - Cough
    - Hoarseness
    - Dyspnea
    - Altered Mental Status
- Assess Severity of Injury

Clinical Evaluation

- Determine Severity of Injury
  - Size
  - Depth/Degree
  - Location-
    - Hands, face, genitals, feet, circumferential wounds
  - Rule of 9's

Rule of Nines



Initial Burn Management

- ABCs/IV/O2/Monitor
- Identify and treat associated injuries
- Remove source, protect rescue
- Initial cooling with cool water (not cold)
- Cover with dressing, leave blisters intact as biological dressing
- Brush off any metal other material
- Irrigation for chemical burns

Acute Management

- Airway Management
  - Secure airway early even if only mild signs of impending airway edema
  - Signs of impending airway obstruction
    - Hoarseness, Stridor, Facial edema
  - Endotracheal intubation or surgical airway if Endotracheal tube placement not possible
  - Give 100% O2 for suspected smoke inhalation

Acute Management

- Fluid Resuscitation
  - Parkland Formula
    - 4 x (% body surface burned) x weight (kg)
    - This equals the amount of fluid (in ml) to replace in a 24hr period starting from time of injury
    - First half in the first 8hrs
    - Remaining half in the next 16hrs
  - Urine Output > 0.5-1.0 cc/kg/hr
  - Pediatric Considerations

Acute Management

- General Wound Care Principles
  - Biological Dressing
  - Wound Debridement
- Topical Antibiotic Agents
  - Silvadine cream
  - Covering the wound with clean linens
- Analgesia
  - Often very painful and require large amount of pain medication

Do's and Don'ts of Burn Care

- Do's
  - Brush off dry chemical while in a protective suit
  - Flush with cool water
  - Cover wound with dry dressing
  - Keep victim comfortable
- Don'ts
  - Apply ice
  - Touch the burn
  - Remove pieces of cloth from burned area
  - Clean severe burns
  - Break blisters
  - Use ointment on severe burns

Acute management

- Escharotomy
  - Deep circumferential burns over neck, chest limbs
  - Compromised ABC's
  - May be life or limb threatening
  - Incision of eschar to sub Q fat
  - Avoid major vessels and nerves
  - Anesthetics usually not required

Escharotomy

Image removed of escharotomy (surgery to treat 3rd degree burns)

Copyrighted image for which we don't have permission and cannot claim fair use

Acute management

- Inhalational Injuries
  - Responsible for most deaths
  - Evolution may require several days
  - Exposure of airways and lungs to toxic chemicals
    - Tracheobronchitis
    - Airway obstruction
    - Pulmonary edema within 2-3 days
- Carbon Monoxide Poisoning
  - Has higher affinity for hemoglobin than O2.
  - CO poisoning can lead to AMS, myocardial ischemia, and severe long term neurologic sequelae
  - O2 in higher concentrations accelerates CO elimination
  - Can also treat with amyl nitrate, sodium nitrite, sodium thiosulfate

Complications of Burn Care

- Infection
- Airway Considerations
- Circumferential Burns

Questions?

Dkscully, Flickr