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# Advanced Emergency Trauma Course

Environmental Injuries



Presenter: Carl Seger, MD

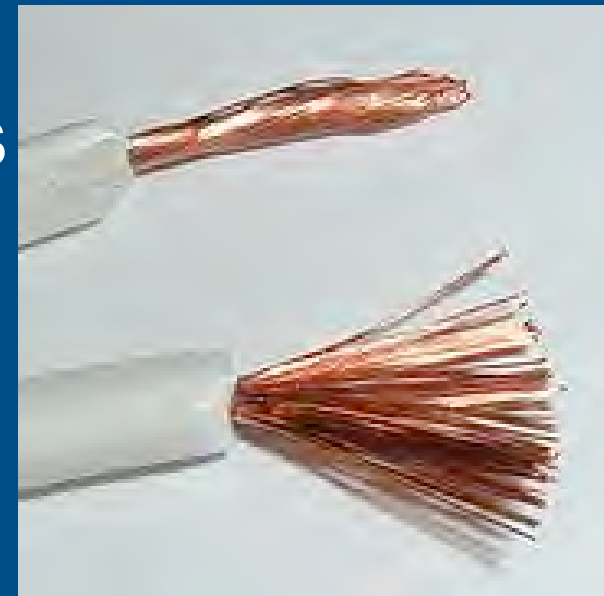
Ghana Emergency Medicine Collaborative

Patrick Carter, MD • Daniel Wachter, MD • Rockefeller Oteng, MD • Carl Seger, MD

# Electrical Injuries

## ■ Definitions

- Lightning Injuries
- Alternating Current Injuries
  - Low Voltage
  - High Voltage
- Direct Current Injuries



 PD-Self

[Wikipedia](#)

# AC vs. DC

AC

Household Current

DC

Batteries

Railroad Tracks

Car Electric Systems

Lightning

# AC vs. DC

## ■ Alternating Current

- Requires lower energy to cause damage
- Findings:
  - Tetany
  - Resp Paralysis
  - Burns
- Large Exit wounds
- Ventricular tachycardia

## ■ Direct Current

- Single muscle spasm that throws victim from source
- Decreased exposure but more blunt trauma
- Smaller exit wounds
- Asystole

# AC: Low Voltage 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
- 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.)



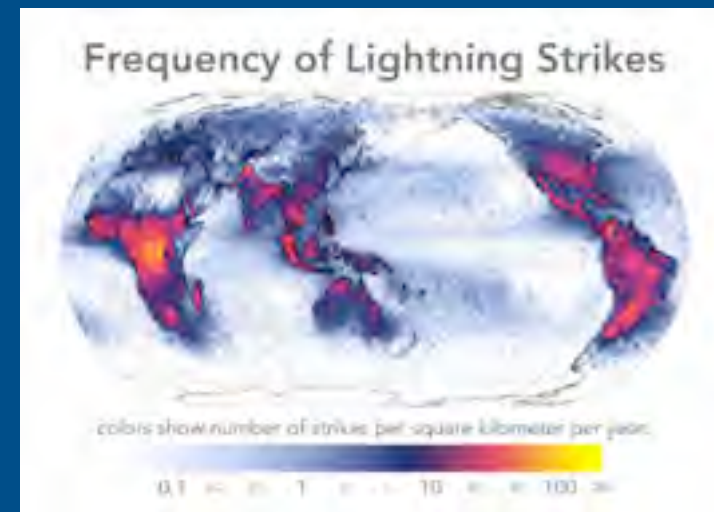
Koumbourlis, AC. Electrical Injuries. Crit Car Med 2002; 30:S425

# Lightening Injuries

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



Adapted from a photo by PeWu  
([Flickr](#))



Citynoise ([Wikipedia](#))

# Lichtenberg Burn



Source Undetermined

# 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
- Lightning: 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

# Children

## ■ Electrical Cord

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



PD-INEL

Source Undetermined

# Bites

- Snake Bites (4 Classes)
  - Atractaspididae
  - Elapidae (Sea Snakes)
  - Viperidae (inc Pit Vipers)
  - Colubridae
    - Long considered harmless
    - Now recognized to contain a number of species with venoms dangerous to humans



## Atractaspididae: Green Mamba



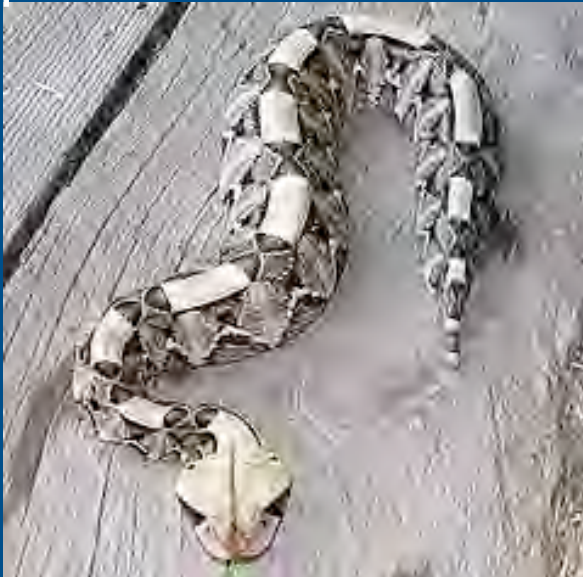
 Cotinis ([Wikipedia](#))

## Elapidae: Black Necked Spitting Cobra



 Mwherr ([Wikipedia](#))

## Viperidae: West African Gaboon



 Jwinius ([Wikipedia](#))

## Viperidae: Carpet Viper



 Tim Vickers ([Wikipedia](#))

# Snake Bites

- There is no quick, simple, and absolutely reliable method for distinguishing venomous from nonvenomous snakes.

# Poisonous African Snakes

- Vipers, adders
- Long-nosed viper
- Saw-scaled or carpet vipers
- West African Gaboon
- Puff adder
- African spitting cobras
- Egyptian and snouted cobras
- Mambas

# Factors affecting severity of Snake bite

- Dose of venom injected—depends on mechanical efficiency of bite and species and size of snake
- Composition and hence potency of venom depends on species and, within a species, the geographic location, season, and age of the snake
- Health, age, size, and specific immunity of human victim
- Nature and timing of first aid and medical treatment

# Clinical Presentation

- Local Reaction- swelling, bruising, tissue necrosis
- Cardiovascular- hypotension
- Renal Failure- rhabdomyolysis
- Coagulopathy
- Nervous System- (spitting cobras) Paralysis of Bulbar muscles and respiratory nerves

\*most symptoms don't start for 1-2 hrs

# Labs

- CBC
- Electrolytes
- Coagulation studies
- LFT' s
- UA

# Treatment

- ABC's
- Don't open the wound,
- Tourniquet
  - Only to impede venous return, SHOULD NOT impede Arterial delivery
- Antivenom
  - Monovalent- if you know the type of snake
  - Polyvalent- Snake not known

# Antivenom

- In Short Supply
- Problem may be relieved by new African Polyvalent
  - Raised against appropriate African venoms
  - Manufactured outside of Africa
- Antivenom treatment complications
  - Early (Anaphylactoid)
  - Pyrogenic
  - Late (serum-sickness)



# Bites

- Cat Bites
  - Very infectious
  - Puncture wounds
  - Do not close
  - Treat for *Pasturella multocida*
    - Amoxicillin/clavulanate



 PD-Self

[Wikipedia](#)

# Bites

## ■ Dog Bites

- Not as infectious as cats
- Puncture wounds
- If going to close, make sure the wound is very clean!!!!!!!!!!!!!!
- Treat for *Pasturella multocida*
  - Amoxicillin/clavulanate



Bruno: Photo by Carl Seger, MD

# Marine Envenomations

- Scomboid (tuna, mahi-mahi)
- Ciguatera (coral reef fish, red snapper, sea bass)
- Tetrodotoxin (Puffer fish)
- Sting Rays
- Nematocyst (jellyfish)

# Scombroid (tuna, mahi-mahi)

- Heat stable toxin
- Causes release of Histamine
- Peppery, bitter taste
- Onset 20 min
- Flushing, headache, diarrhea
- Symptoms gone in 6hrs
- Treat with antihistamine



PO-SELF

Fcbaum ([Wikipedia](#))

# Ciguatera

(coral reef fish, red snapper, sea bass)

- Tasteless odorless heat and acid stable toxin
- Cooking, freezing, drying, salting will not eliminate the toxin
- GI and Neuro symptoms (hot and cold reversal)
- Last 1-2 weeks
- Supportive care, Mannitol may help



PD-GOV

NOAA - National Oceanic and  
Atmospheric Administration  
([Wikipedia](#))

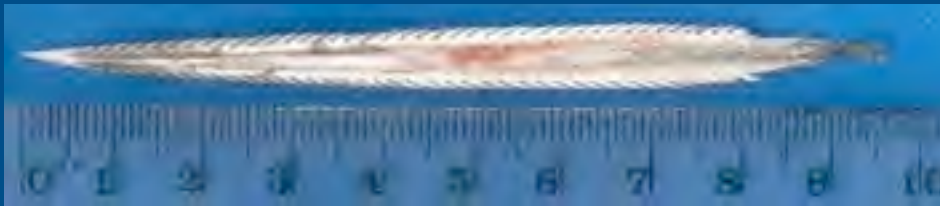
# Tetrodotoxin (Puffer fish)

- Acts on Na channel to stop axonal transmission
- CNS, GI, and cardiac effects, rapid onset
- Lip and tongue paresthesias that progresses to involve the whole face
- N/V/D, hypotension and bradycardia
- High mortality, no antidote, supportive, early airway control



# Sting Rays

- Venomous spine
- Can puncture and lacerate
- Diarrhea, vomiting, seizures, paralysis, hypotension, and dysrhythmias
- No treatment, supportive care



 Doka54 ([Wikipedia](#))



 Dan Hershman ([Wikipedia](#))

# Nematocytes (jellyfish)

- Remove without letting them discharge
- Pain
- Wash with sea water
- Pour Vinegar slurry on them
- Cover with talcum powder or shaving cream
- Scrape or shave off
- Then wash again in sea water
- Apply topical steroid cream, treat secondary infections



 BY-SA

Mila Zinkova ([Wikipedia](#))



# Stings

- Hymenoptera
  - Bee's, Wasps, Hornets, fire ants
- Sting reactions
  - Local
  - Systemic
  - Acute sever systemic



 PD-GOV

[Wikipedia](#)

# Hymenoptera

## ■ Local Reactions

- Pain, itching, erythema, urticaria
- Can look like cellulitis in 1-2 days



SuperManu, Waugsberg ([Wikipedia](#))

# Hymenoptera

- Systemic Reaction
  - Generalized urticaria
  - Flushing and vasodilation
  - Cramps, vomiting, and diarrhea

# Hymenoptera

- Acute Severe Systemic
  - Ig-E mediated
  - Occurs rapidly with in 10-20 min
  - Usually with 1-2 stings
  - Hypotension, arrhythmias, laryngeal edema, bronchospasm, stridor
- Treatment
  - Epinephrine (1:1000) IM 0.4 mg in adults and 0.01 mg/kg in peds
  - H1 and H2 blockers, Steroids

# Near Drowning

- Often affects youth
- Pts prognosis depends on how quickly they are rescued and resuscitated
- ALWAYS treat the pt as if they have a head and/or C-Spine injury.
- Prevention is the Key



# Near Drowning

- Hypoxemia- from flooding of alveoli and impairment of gas exchange
- This occurs with approximately 2.2 ml/Kg of fresh or salt water.
- Aspiration of particulate matter contributes to lung injury
- This all results in non cardiogenic pulmonary edema

# Near Drowning

- Clinical Manifestations
  - Hypoxemia
  - Neurogenic Shock
  - Electrolyte abnormalities



 Ex nihil ([Wikipedia](#))

# Near Drowning

## ■ Evaluation

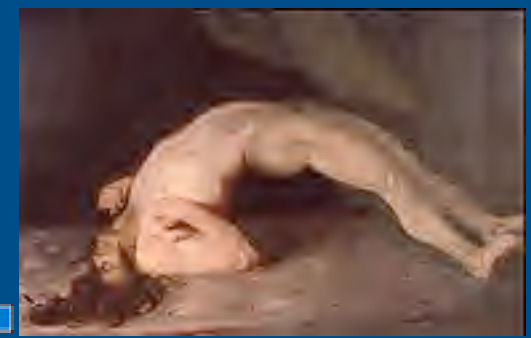
- CBC
- Electrolytes
- Clotting studies
- ABG
- CXR
- C-Spine films possibly CT of C-Spine



# Near Drowning

- Management
  - ABCDE
    - Airway with high flow O<sub>2</sub> and PEEP
    - ACLS if needed
    - Immobilize C-spine
  - Treat electrolyte abnormalities
- Admit pts who recover but have any respiratory complaints and they might develop pulmonary edema

# Tetanus



Sir Charles Bell, 1809 ([Wikipedia](#))

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



Center for Disease Control ([Wikipedia](#))



Center for Disease Control ([Wikipedia](#))

# Heat illness

- Heat Gain
  - Metabolism- would heat up body 1.1 degree per hour
  - Environmental
- 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, vasodilation, if temp higher then we gain heat

# Heat illness

## ■ At Risk

- 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 and liver function
- Treatment
  - Passive cooling, cool IVF

# Heat Stroke

- Temp > 40.5 degrees
- Same symptoms of exhaustion but neurologic involvement
  - AMS, hallucinations, ataxia, seizures
- Physical Exam
  - Altered
  - Tachycardia- arrhythmias resistant to Cardioversion
  - Tachypnea



# Heat Stroke

## ■ Labs

- Coagulopathy
- Elevated Liver Enzymes
- Hematuria
- Elevated CK

# Heat Stroke

## ■ 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

# Questions?



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