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Advanced Emergency Trauma Course

Environmental Injuries

Presenter: Carl Seger, MD
Electrical Injuries

- Definitions
  - Lightening Injuries
  - Alternating Current Injuries
    - Low Voltage
    - High Voltage
  - Direct Current Injuries
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

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

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 (arrhythmias)
  - Renal function monitoring

Adapted from a photo by PeWu (Flickr)

Frequency of Lightning Strikes

Colors show number of strikes per square kilometer per year.
Lichtenberg Burn

Source Undetermined

Ghana Emergency Medicine Collaborative
Advanced Emergency Trauma Course
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 neurvascular compromise
  - Abnormal EKG, or suspected dysrrhythmia
  - Abnormal UA
Children

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

Viperidae: West African Gaboon

Elapidae: Black Necked Spitting Cobra

Viperidae: Carpet Viper
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 multicida
    - Amoxicillin/clavulanate
Bites

Dog Bites
- Not as infectious as cats
- Puncture wounds
- If going to close, make sure the wound is very clean!!!!!!!!!!!!
- Treat for Pasturella multicaida
  - Amoxicillin/clavulanate
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
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
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 dysrrhythmias
- No treatment, supportive care
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
Stings

- Hymenoptera
  - Bee’s, Wasps, Hornets, fire ants

- Sting reactions
  - Local
  - Systemic
  - Acute severe systemic
Hymenoptera

- Local Reactions
  - Pain, itching, erythema, urticaria
  - Can look like cellulitis in 1-2 days
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
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 O2 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

- 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)
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?
References

- Auerbach, P. Snakes Bites, in *Wilderness Medicine, 5th.* Mosby.