





Environmental Evidence of Lightning • Trees showing lightning damage **Environmental Evidence of** Lightning Damage to ground Damage to fruit Environmental Evidence of Lightning: Fulgurites in Sand or Soil (bone or tube-like structures)

Lightning Strike

- Instantaneous duration of contact
- "Flash-over" effect may explain low overall mortality rate of 30%
- Of the survivors, >70% left with disabilities
- Water conducts electricity; current takes path of least resistance to ground
- Wetness on body increases "flash-over" effect
- Vaporization of moisture into steam produces explosive force--damages clothing & may blow off shoes

Lightning Strike

- Asystole or ventricular fibrillation:
 - Cardiac automaticity may restore rhythm, but thoracic muscle spasm & medullary respiratory center damage cause secondary hypoxic cardiac arrest
- Brain injury & multisystem trauma
- → Ruptured tympanic membranes, blindness, cataracts & retinal detachment from heat / blast
- Immediate but transient paralysis lasting minutes to hours (keraunoparalysis)

Lightning Strike Burn Injury

 Superficial to full thickness, linear charring or contact burns from overlying metal objects





Lightning Strike Management Victims NOT electrically charged CAB / CPR / AED / ACLS interventions Spinal stabilization Burn care if needed Beware of storm threat to rescuers! Fasciotomy for cold, pulseless extremities not indicated (keraunoparalysis resolves over course of hours)

Lightning Strike • Mass Casualty Management: • "Reverse triage": care for cardiopulmonary arrest victims first! (those with "signs of life" have highest survival rate) • Immediate CPR: • CAB / AED • ACLS interventions

Lightning Strike Prevention Pay attention to weather forecasts (NOAA) Choose location & timing of hike, e.g., in Colorado during summer, plan hikes in AM Seek shelter when thunder is heard!

Lightning Strike Prevention • 30 / 30 Rule: • If "flash to bang" is 30 seconds or less, danger exists • Remain sheltered until 30 minutes after last thunder is heard

Consider Carrying a
Lightning Detection Device

Lightning Strike Prevention Substantial buildings or fully enclosed metal-topped vehicles are the safest shelters (not an isolated shed, tent, or shallow cave entrance) Do not stand near open doors, windows, fireplaces or metal objects Turn off electrical appliances Do not talk on a corded telephone

Lightning Strike Prevention If caught outside: do not stand under the tallest tree or object--lightning is attracted to the highest point Instead, choose a stand of trees

Lightning Strike Prevention • Get out of water (even indoor bathtub or shower)

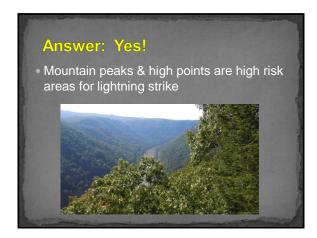
Lightning Strike Prevention

- Signs of imminent strike: hair standing on end, seeing blue halos around objects (St. Elmo's fire), hearing high-pitched or crackling noises
- St. Elmo's fire: plasma energy from ionized air that glows blue due to an imbalance in electrical charges
- Do NOT sit or lie flat on the ground!



Answer: Yes! • Entrances to shallow caves are high risk areas for lightning strike • Surface / ground arcing can occur





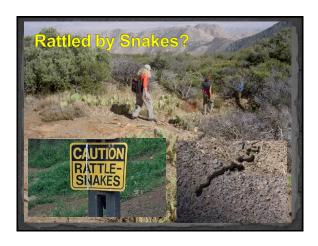


Answer: No! Rubber-soled boots offer no protection against lightning



Answer: Yes! Vehicles can be struck by lightning -- rubber tires offer no protection Electrical systems can short-out & catch on fire But...there have been no recorded fatalities of passengers in fully-enclosed, metal-topped vehicles

Keep in Mind the Risk of Indirect Lightning Damage to Vehicle	
Motorcyclist "Zapped in Head" by Lightning Survives	
Lightning Strike Video	



Poisonous Snake Bite Facts (US) • Native to all states except Maine, Alaska & Hawaii • Bite ~ 4,700 people / year • Pit vipers are venomous at birth

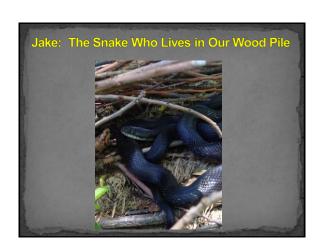
Poisonous Snake Bite Facts (US) Snake bite-related deaths: 2 to 5 deaths per year More common in children & elderly Associated with no use of antivenin, inadequate or late dose Usually occur 18 - 32 hours after envenomation, but may occur earlier

Crotalidae: Pit Vipers Rattlesnakes, Cottonmouths & Copperheads Have a foramen or pit between each eye & nostril - heat sensitive - enables snake to locate warm blooded prey Triangular head due to venom glands Single row of subcaudal scales

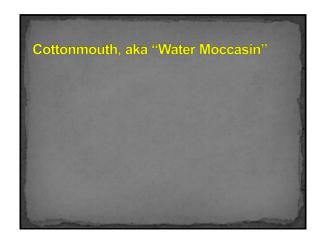
Crotalidae: Pit Vipers Two curved, canalized fangs--retract when mouth closed apairs replacement fangs; fang replacement occurs throughout snake's life Snake regulates venom quantity based on size of prey Can inject from one or both fangs Amount of venom injected variable in defensive bites









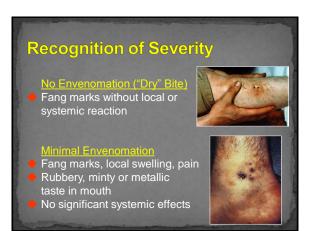




Venom Composition Procoagulants Anticoagulants Neurotoxins Hemotoxins

- Cardiotoxins
- Effects include system toxicity, biologic tissue & blood cell destruction
- <u>Interspecies variability</u> in components of snake venom
- Venom immobilizes, kills, & digests prey!

Manifestations Related to: Size of the snake (large = more venom) Potency & amount of injected venom Depth of envenomation Location of bite (vascular puncture or a bite to face or neck can produce immediate crisis) Number of strikes (not all venom is injected with each bite; more bites = greater envenomation) Size & underlying health of victim



Recognition of Envenomation Severity Moderate Envenomation Fang marks with local & systemic effects: pain, nausea, vomiting, paresthesias, fasciculations, swelling beyond bite site, mild coagulopathy Severe Envenomation Fang marks with severe swelling / local response, severe systemic manifestations, including hypotension & seizures Marked coagulopathy





Field Interventions

- Move victim to safety away from snake
- Place victim at rest (exertion speeds venom effect)
- Remove jewelry & tight clothing
- Splint & immobilize bitten extremity at heart level
- Evacuate to hospital ASAP

Field Interventions



- Apply ice
- Apply a tourniquet
- Incise or suck wound
- Capture / handle snake
- Use "extractor" devices

**Note: Even DEAD or decapitated snakes can inflict a bite -- take a digital photo instead!

Advanced Interventions



- Vascular access
- Supportive ALS care
- ➤ Contact Poison Control center
- >Wound care
- Tetanus prophylaxis
- Antibiotic prophylaxis not routinely indicated

Advanced Interventions

- Obtain baseline diagnostic studies
 - ►EKG,
 - >CBC.
 - ➤ Coagulation profile
- Consider radiographic imaging to identify the presence of foreign bodies in wound
 - Embedded teeth or fangs in bite wound possible, but very <u>rare</u>

Advanced Interventions



- Prophylactic fasciotomy <u>not</u> recommended; swelling from myonecrosis typically resolves with adequate antivenom administration
- Blood product transfusion <u>not</u> recommended
 Adequate antivenom dosing will usually reverse coagulopathy
- Consider antivenom (CroFab) administration

CroFab--Crotalidae Polyvalent Immune Fab (Ovine)

- IV product used to treat North American crotalid envenomation
- Specific antibody fragments of immunoglobulin G (IgG) bind & neutralize toxins
- Enhanced safety profile: No skin testing
- Administer within 6 hours if possible
- Reverses coagulopathy & decreases edema

CroFab--Crotalidae Polyvalent Immune Fab (Ovine)

- <u>Dose</u>: Reconstitute with 10 ml sterile normal saline
- Add 4-6 vials to 250 ml NSS & infuse over 1-hour (slowly for first 10 minutes)
- Repeat 4-6 vials if needed, then 2 vials q6h X 18 hours (same dose for adult & peds)
- Contraindicated in known hypersensitivity to ovine (sheep) products & papain / other papaya extracts

CroFab--Crotalidae Polyvalent Immune Fab (Ovine): ADR's

- Serum sickness:
 - Type III hypersensitivity reaction
 - Develops within 3 to 21 days
 - Skin rash appears first; progresses to fever, joint pain, malaise & pruritus
 - Treated with oral steroids & diphenhydramine
- Allergic reactions (usually mild to moderate):
 - Pruritus & urticaria
- Anaphylaxis rare, but more likely after prior CroFab treatment – sensitization can occur

Coral Snake – <u>Not</u> a Pit Viper, but a venomous elapid

"Red on yellow, kill a "Red on black, fellow." venom lack."

Coral Snake

- Generally non-aggressive
- Account for <1% of venomous snake bites in US
- Found in southeastern & southwestern US
- No fangs; small teeth
- Venom injected via chewing motion & spread by lymphatic system
- Venom contains neurotoxins & myotoxins
- Effects may be <u>delayed</u> up to 13 hours; prolonged observation indicated

Coral Snake

- Manifestations: Nausea, vomiting, weakness, cranial nerve deficits (ptosis, diplopia, dysphagia), paresthesias, altered mental status, fasciculations & respiratory paralysis
- Treatment:
 - Pressure immobilization / compression technique (distal to proximal extremity wrap)
 - Contact Poison Control Center
 - Supportive care / mechanical ventilation
 - Antivenom no longer being manufactured in US
 - Venom effects may persist for days

Snake Bite Prevention

- Don't molest snakes use common sense!
- Don't keep venomous snakes as pets
- Stay out of striking distance
- Use caution in snake-infested areas: rocks, tall grass, caves & heavy underbrush
- Don't put hands & feet where eyes can't see
- Wear boots & protective clothing







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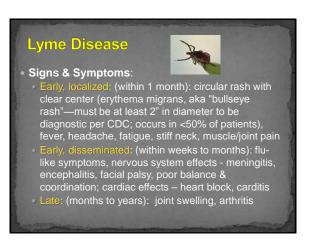






Named after town of Lyme, CT, when clusters of juvenile rheumatoid arthritis cases were identified Discovered the children all played in woods, had a history of tick bite & a circular rash at bite site 1981 – researchers confirmed Lyme caused by bacteria (Borrelia burgdorferi) transmitted by bite of black-legged tick (deer tick) Both adult ticks & nymphs (immature ticks) transmit Lyme; most cases caused by nymphs







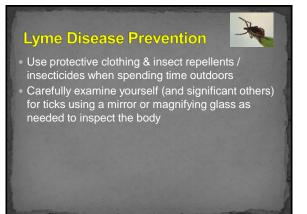
Lyme Disease Diagnosis



- Lab studies <u>not</u> recommended for people without symptoms
- CDC: Two-test approach for active disease & previous infection using a enzyme-linked immunosorbent assay (ELISA) followed by a Western blot if positive or equivocal
- Positive test = both tests positive
- ELISA only a 65% sensitivity; 20-30% of those with Lyme may have a negative Western Blot
- Clinical judgment necessary for diagnosis & decision to treat

Lyme Disease Treatment

- Early stage disease: oral antibiotic treatment with doxycycline, amoxicillin, or cefuroxime (Ceftin)
- Ceftriaxone IV when neurologic symptoms are present
- Criteria regarding when to initiate treatment as well as the schedule / duration of therapy remain controversial



Lyme Disease Prevention Tick Removal: A tick must feed for 36 to 48 hours to transmit disease #1 - Grasp tick with fine-tipped tweezers close to skin; pull steadily & firmly until tick lets go #2 - Save tick in container with 70% alcohol #3 - Wash area with soap & water #4 - Monitor for signs / symptoms of Lyme disease

Lyme Disease Prevention 2002: Lyme vaccine discontinued due to low demand; those vaccinated no longer protected Lyme cannot be transmitted person to person; pets (dogs & cats) can get Lyme disease, but can't infect people Pets can harbor ticks & bring ticks into home Use tick control measures Inspect pets for ticks A high heat setting in the dryer will kill ticks that may still be attached to clothing





Tick & Mosquito Prevention The prevention rule: DON'T GET BITTEN Mosquitoes are most active dusk & dawn Eliminate standing water where mosquitoes lay eggs Don't handle dead birds (may have West Nile virus) Wear protective clothing: Long sleeves, loose, pants tucked in socks Tightly woven fabrics (ex. Nylon) Window & door screens in good repair Mosquito nets Use chemical repellants / insecticides

Permethrin

- Pyrethrum is a powerful, rapidly acting insecticide marketed as Permethrin
- Not a repellant
- Low toxicity in mammals
- Apply directly to clothing, tent walls, or mosquito nets
- Do not apply to skin

DEET

- Considered Gold Standard of insect repellents
- Applied directly on skin, not clothing
- 25% DEET provides 4 to 8 hours protection
- Use high concentration (30-35%) in a malaria-endemic area

Insect Bite Protection

- DEET: 25% DEET: 4 to 8
 hours protection
- Picaridin: Similar efficacy to DEET for up to 8 hours
- Eucalyptus: Average protection 4 to 7.5 hours; similar efficacy to DEET
- Permethrin-treated clothing + DEET or Picaridin-based



Bee & Wasp Stings

- Local pain to life-threatening envenomation& anaphylaxis
- Except for honey bees, bees & wasps have tendencies to sting repeatedly; <u>venom</u> <u>doses are cumulative</u>
- Honey bees die after stinging





Africanized or Killer Bees



- Hybrid of European & African honey bees; "feral" bee colonies take over territory
- Smaller in size than European bees
- Often have ground colonies
- Found in TX, CA, NV, AZ, AK, NM, GA, LA, FL
- More irritable, swarm more quickly, defend territory more aggressively & sting collectively
- Hundreds of stings possible in single attack
- Venom similar to European bees; cumulative toxic effects from mass stinging

Africanized or Killer Bees

- Median lethal dose of honeybee venom estimated at 19 stings per kg, or 500 to 1,400 stings for humans
- Stinging induced by:
 - Sudden movements
 - Dark colors
 - Odors, including human perspiration
 - Pheromones released from bees during stinging episodes
 - Disturbing the hive

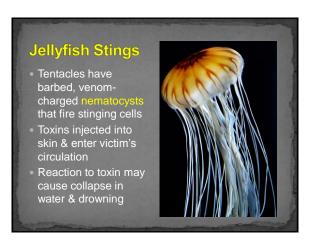






Bee & Wasp Stings • Anaphylaxis: incidence is 0.3 to 8% in population • Assist victim to use own Rx epinephrine • Arrange for advanced life support care • IV access, monitoring, epinephrine (IM or IV), albuterol, parenteral antihistamines (H1 blockers), H2 blockers, corticosteroids

Bee & Wasp Stings: Prevention Strategies Do not disrupt hives or nests; use care when mowing lawn When in a high-risk area, wear long sleeve shirts, pants & shoes to protect skin from stings Use screens in open windows Secure trash in closed containers Avoid perfumes when spending time outdoors If allergic, carry an epinephrine pen & consider immunotherapy to desensitize



Jellyfish Stings Rash with stinging, itching, tingling, burning & intense throbbing pain Red-brown-purple tentacle prints or welts Skin infection can occur Multiple, body-wide effects including muscle spasms, nausea, vomiting diarrhea, stomach pain, severe pain at sting site Anaphylaxis Organ failure, coma & death

Jellyfish Stings: Treatment

- Prevent firing of nematocysts:
- Wash area with sea water (not freshwater)
- Hot water or topical lidocaine best for pain
- Do not rub or compressVinegar, though widely advocated, increases pain from nematocyst discharge; effective only in stings from Physalia species
- Remove tentacles with tweezers or gloved hand
- Shave area with shaving cream or baking soda paste to remove nematocysts
- in control (ibuprofen, acetaminophen), diphenhydramine, tetanus immunization

Jellyfish Stings

- Allergic / Anaphylactic Reaction:
 - •Immediate care essential

 - Advanced life support
 - → Novanced life support → IV access, monitoring, epinephrine (IM or IV), albuterol, parenteral antihistamines, H2 blockers, corticosteroids
 - Supportive care



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