

A Nor-Cal EMS Webcast for Continuing Education

Presented by Eric M. Rudnick, MD, FACEP, FAAEM, Medical Director,
Northern California EMS Agency at the April 2014 10th Annual Northstate
Prehospital Conference and recorded live April 26, 2014.

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Envenomation, Bites, and Stings Part I, and
Case Studies, Part II presented by by Eric
Rudnick, M.D. Medical Director, Nor-Cal
EMS, and recorded live at the April 26, 2014
10th Annual Prehospital Conference by
Engineer Bill Bogenreif.

Envenomations, Bites, and Stings

Northern California EMS Conference
April 26th, 2014

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Absolute Safety Training – Paramedic Program

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Broad Categories

- Marine life
- Mammals – focus on Dogs and Cats
- Arthropods
- Bees and Wasps
- Arachnids
- Reptiles - Rattlesnakes



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Stingrays

- Pain, bleeding and infection are the major risks from stingrays.



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Stingrays

- Cartilaginous fish with “wings” with enormous size variations
- Whip like tail with retroserrated barbs with a dorsal groove containing venom glands
- Tropical and subtropical waters (fresh and salt)
- 11 species found in the United States

Stingrays

- Intense pain and edema
- Symptoms can include weakness, nausea, vomiting, syncope, and even seizures
- Mortality is secondary to trauma if struck in the chest (Crocodile Hunter) or abdomen
- Immersion into hot water, 110 to 114 degrees F
- Surgical exploration may be needed
- Antibiotics



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Sea Urchins

Pain, burning, erythema, and infection are the major issues with sea urchin spines.



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Sea Urchins

- Neurotoxin
- Issues with spines needing surgical extraction and disintegrate easily
- Joints are high risk
- Imaging may be needed
- Claims with multiple punctures: paralysis, bronchospasm, and hypotension
- Analgesia and/or submersion in hot water (105 to 115 degrees F)
- Antibiotics

Lion Fish

Their appearance and name says don't mess with me!
Poisonous spines everywhere
A favorite for salt water hobbyists



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Lion Fish

Extreme pain , edema and swelling, diaphoresis, chest pain,
hypotension, and syncope

Tissue necrosis and delayed wound healing is
common



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Portuguese Man of War

- Often found shallow water or washed up on the beach
- Nematocysts can remain active for months
- Colonial bodies (Siphonophora)
- Up to 750,000 nematocysts per each tentacle (40 total)
- Tropical and Subtropical waters
- Atlantic Ocean, Gulf Stream, Indian and Pacific Oceans



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Portuguese Man of War



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Portuguese Man of War

- Toxins can cause hemolysis, mast cell degranulation, vasodilation, and conduction disturbances
- Linear erythematous rash, can lead to necrosis in extreme cases
- Onset of symptoms can be delayed
- Anaphylaxis
- Malaise, myalgias, spasms, delirium, syncope, and ataxia
- Severe envenomation: Dysrhythmias, hypotension, respiratory depression, and even death (rare)



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The Humane Society of the United States

- http://www.humanesociety.org/animals/dogs/tips/avoid_dog_bites.html
- Cesar Milan
- <http://www.cesarsway.com/channel/dog-behavior/dog-biting>

***Any dog given the correct
circumstances can and will bite***

Mammal Bites By Species in the U.S.

- New York City
 - Dogs : 89 %
 - Cats : 4.6 %
 - Rodents : 2.2 %
 - Humans : 3.6 %
- Ohio
 - Dogs : 91.6 %
 - Cats : 4.5 %
 - Rodents : 3 %
 - Humans : 0.03 %

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Mammal Bites : Epidemiology in U.S.

- **> 77.5 million pet cats & dogs in U.S.**
- **> 4,500,000 bites / year in U.S.**
- **200 to 800 bites / 100,000 people per year**
- **80 to 90 % of bites due to dogs**
- **1 to 2 % of bites need admission**
- **10 to 18 deaths from dog bites per year**
- **Tremendous economic cost**

Centers for Disease Control and Prevention

- Dog bites: *almost 800,000 are serious enough to require medical attention*
- 32 US dog bite-related fatalities occurred in 2013
- Of the children killed by dogs in 2013, 61% (11) were ages 4 years and younger

Incidence of Dog Bites (By Breed)

Decreasing	German Shepherd : most common
Incidence ↓	Mixed breeds
	Doberman
↓	St. Bernard
	Great Dane
	Rottweiler
↓	Collie
	Pekingese !?!

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Incidence of Fatal Dog Bites (By Breed)

Decreasing	Pit bull : most common
Incidence ↓	Mixed pit bull breeds
	Rottweiler
↓	German Shepherd
	Husky
	Alaskan Malamute
↓	Doberman
	Great Dane

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Epidemiology

- Accounts for 1% of all Emergency Department visits
- Not reported
- Bites are predominantly on the extremities, except in young children, where you see an increase in head and neck injuries.
- Fatal attacks predominately head and neck

Epidemiology

- Dogs typically create crush wounds, while cats create puncture wounds.
- Trained K-9's used in Law enforcement can exert a bite force of up to 800 psi; this can produce exceptional injuries (450 psi can puncture light sheet metal).
- Cats have greater incidence of deep seated infections

Average Infection Rates From Mammal Bites

Dogs :	2 to 5 %*
Cats :	30 to 60 %
Rats :	2 to 10 %
Monkeys :	25 %
Humans :	13 to 50 %**

*However up to 40 % for hand bites

**Higher rates reported mainly from delayed presentations (Closed Fist Injuries)

Risk of Infection

- HIGH
 - Foot, hand, and wrist
 - Puncture wounds and bites over joints, Closed Fist Injuries
 - Delays in treatment > 4 to 12 hours
 - Age greater than 50, immunocompromised, diabetes, vascular disease, alcoholism
- LOW
 - Face, lip, scalp

History

- Type of animal and its status: general health, rabies vaccine status, behavior
- Time and location of event
- Circumstances: provoked/defensive bite versus unprovoked
- Whereabouts of the animal, is it observable?

History

- Past Medical History: diabetes, alcoholism, steroid use, asplenism, organ transplant, cytotoxic drugs, prosthetic joints/valves
- Tetanus status
- Medications
- Allergies

Physical Examination

- Diagram, photograph, or carefully describe type of wound (medical-legal document)
- Presence of swelling, crush injuries, or devitalized tissues
- Range of motion of affected part
- Distal neurovascular status
- Tendon or joint space involvement

Physical Examination

- Bone injury, particularly skull in infants and young children
- Visceral injury (can be occult)
- Need to undress the patient many times
- Foreign bodies(e.g. teeth) in the wound

Treatment - Prehospital

- Inspection of injuries
- Dressings
- Immobilize and elevate extremity
- Hand injuries position of function – holding a can
- Resuscitate if indicated

- **Chemoprophylaxis**
 - Routine antibiotics: Controversial
- **Tetanus Prophylaxis**
 - Elderly at risk
- **Rabies Prophylaxis**
 - Uniformly fatal encephalitis
 - Only 5 documented survivors worldwide

Rabies Incidence in U.S.A.

- **4,000 proven domestic animals / year**
 - **Predominately dogs, cats, cattle**
- **15,000 proven wild animals / year**
 - **Represents sampling by state labs so true incidence is much higher**
- **Average 1 human death / year (about 800 worldwide human deaths reported per year)**
- **Dog most common transmitter of rabies to humans worldwide**

Risk of Rabies Transmission from Animal Bite

<u>High Risk</u>	<u>Intermediate Risk</u>	<u>Low Risk</u>
Bats	"Outdoor" cats and dogs	Rodents
Raccoons	Cattle in Midwest USA	Lagomorphs (hares & rabbits)
Foxes		Farm animals
Coyotes / bobcats		<u>Indoor</u> cats and dogs
Other carnivores		

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Medical/Legal Document

- Medical/Legal pitfalls: Meticulous documentation of history, examination, and treatment for all wounds (dog, cat, human)
- Court rooms are scary places



Dog bite lacerations of the face

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Same patient after primary suture repair

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Same patient after healing, with good cosmetic outcome

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Left flexor tenosynovitis from dog bite requiring surgical management

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Insects

- Phylum Arthropoda: potential exposures and health issues too numerous to fully discuss
- Scabies – a mite (feces/proteins) that causes intense itching; from the Latin “to scratch”
- Bed Bugs – bites (ingest blood) that cause rashes and allergic reactions



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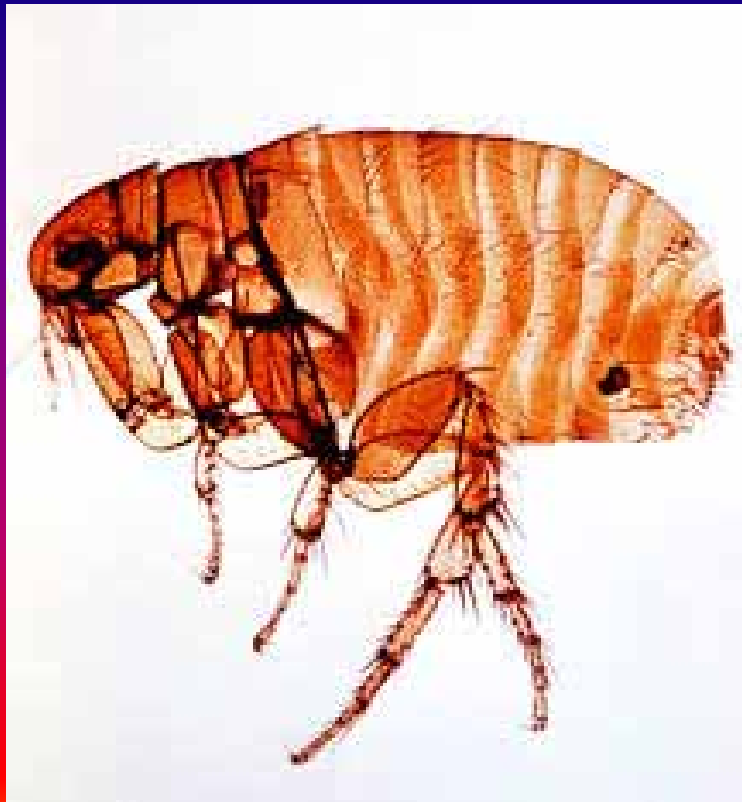
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Insect Exposures

- Fleas – bites (ingest blood) and carry organisms that cause disease: e.g. Plague
- Ticks bites (ingest blood) and carry disease such as Lyme and RMSF
- Remove and save the tick

Insect Exposures

- Female mosquitoes bite and transmit
 - *Malaria, West Nile Virus (Culex species)
 - *Yellow, Dengue Fever and Encephalitis (Aedes)
- Mosquitoes cause allergic reactions - saliva



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Insect Exposures

- Major immediate concern is allergic reactions including : urticaria and anaphylaxis

Reactions

- Pain, erythema, tenderness, warmth, and edema of the surrounding tissues
- Without a clear history from patient the diagnosis can be difficult at best
- Determine the location, number, pattern, and the sequelae of the bite(s)

Treatment and Diagnostics

- No lab studies are needed
- Ice
- Topical and systemic antihistamines and steroids for managing hypersensitivity reactions

Anaphylaxis

- ABC's
- IV fluids
- H1 blockers
 - Benadryl (oral and/or parenteral)
- H2 blockers (oral and/or parenteral)
 - Tagamet
- Best for food reactions e.g. peanuts

Anaphylaxis

- Corticosteroids (oral and/or parenteral)
- Epinephrine
- Inhaled beta agonists
 - Titrate to heart rate and effect – use caution in patients over 50

Anaphylaxis

- Outpatient follow up: desensitization and EpiPen or kit



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Hymenoptera

- Apids (bees), Vespids (wasps, yellow jackets, and hornets), and ants
- More deaths than any other envenomation
- Ants sting 9.3 million people each year
- Hymenoptera sting approximately 1 million per year in the U.S.

Hymenoptera

- Complex venom
- Biogenic amines (histamine, acetylcholine, dopamine, norepinephrine, and serotonin)
- Polypeptides and enzymes

Reactions

- Local
- Toxic (multiple stings)
- Anaphylactic and Anaphylactoid
- Delayed (serum sickness)
- Atypical(encephalopathy, neuritis, and vasculitis)

History

- “Rapid onset of symptoms is the rule with 50% of deaths occurring within 30 minutes of the sting and 75% within 4 hours”.
- Fatal stings may have no prior history of systemic reaction.
- Adults with history of prior systemic reaction have 60% chance of similar reaction.

History

- Time and number of stings
- Offending species
- Previous Hymenoptera reactions
- Pre-existing medical conditions
- Time of onset, progression, and nature of current symptoms

Physical Examination

- Local
 - redness, swelling, warmth, and tenderness
 - Ant sting vesicles
- Urticaria
- Generalized (anaphylactoid & anaphylaxis)
 - Urticaria, vomiting, tachypnea, hypotension
 - Angioedema, delirium, shock, death

Physical Examination

- Focus on:
 - Vitals
 - Upper airway and remaining respiratory tract
 - Cardiovascular system
 - Integument

Treatment

- Remove stinger (scrape) - use blunt semi-rigid object. Don't apply pressure to apparatus (stinger and venom organ)
- Epinephrine and volume
- H1 & H2 blockers
- Corticosteroids
- Beta adrenergic inhaled agents
- Early airway management intubation

Outpatient Treatment

- Education
 - Avoid perfumes, don't flail, avoid bright colors, and don't use noisy machines near hives
 - Referral to allergist
- Prophylaxis for 3 to 5 days

Spiders

- 20,000 spider species found in the United States, all but two are considered venomous.
- Small quantities of venom and weak delivery systems limit severe toxicity in many spiders.



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Latrodectus Epidemiology

- 5 species of widow spiders, only 3 are black
- Relatively shy and non-aggressive
- Not found in Alaska
- Only female is toxic

Latrodectus Pathophysiology

- More potent than pit viper venom
- Works at the neuromuscular junction (pre-synaptically) and opens cation channels. Acetylcholine and catecholamines are released, re-uptake is blocked.
- Effects are neurologic and autonomic

Latrodectus Effects

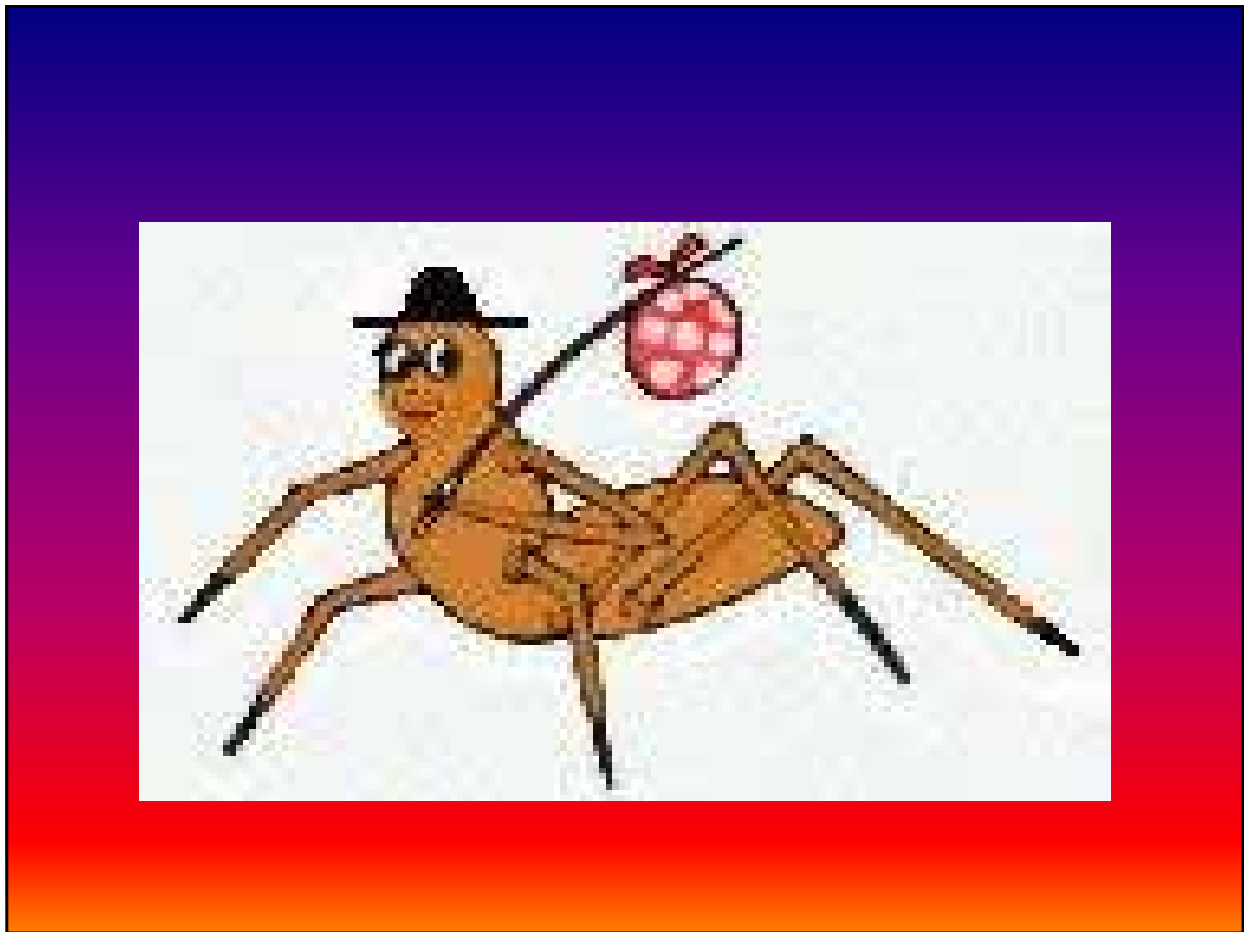
- Sometimes not particularly painful, may be initial burning
- Local effects: onset 1 to 2 hours, erythema, halo-like target lesion, and two small puncture wounds 1 to 2 mm apart
- General toxemia: can occur within 60 minutes, usually only muscle cramps and spasms

Latrodectus Effects

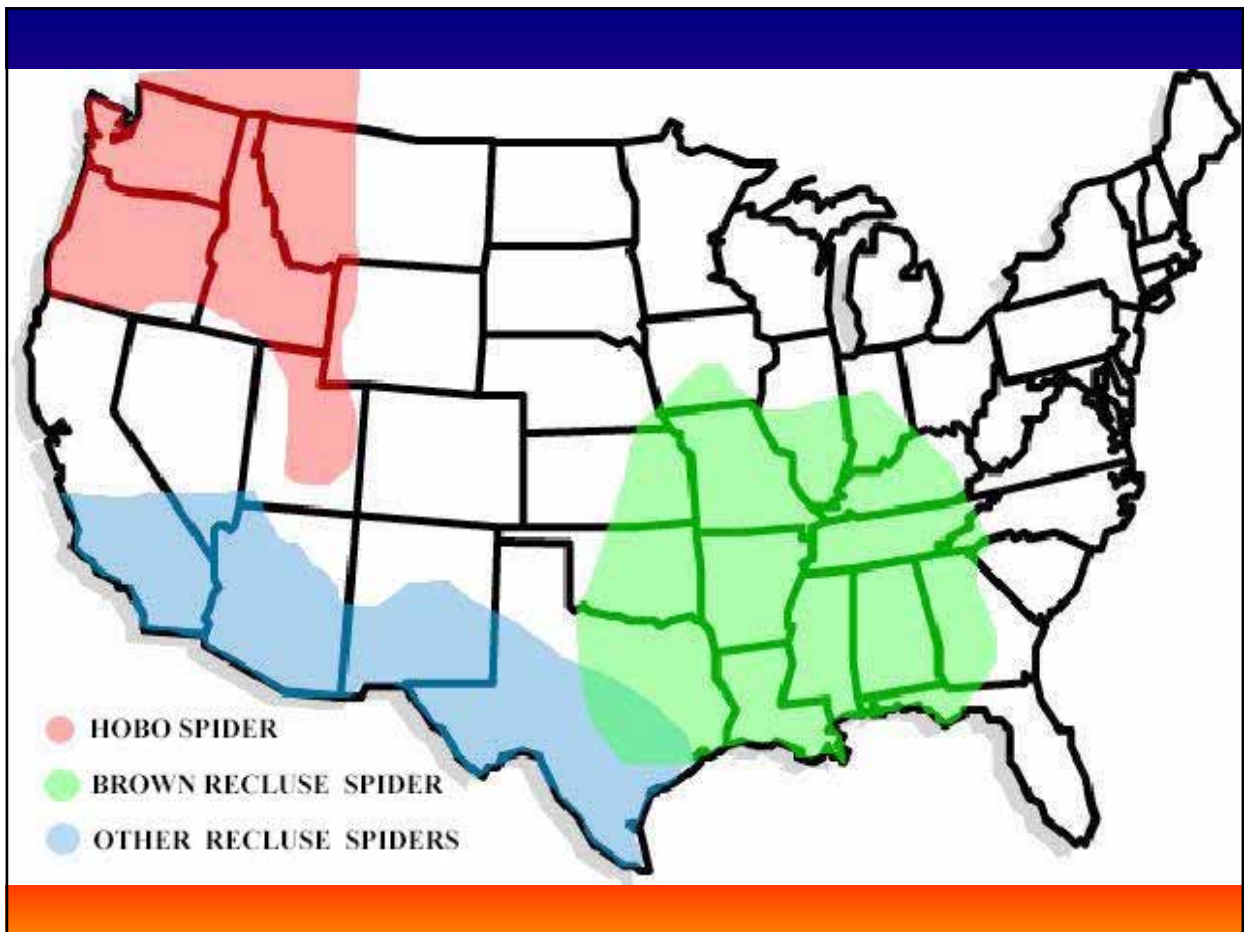
- Systemic: muscle pain which is unremitting and migration of pain
- Autonomic dysfunction can see “sludge”
- Concerns in pregnancy, children and elderly
- Paresthesias, nausea, vomiting, diaphoresis
- Weakness, fever, HTN (including crisis), seizures, and fasciculation's

Latrodectus Treatment

- Antivenin (age, respiratory failure, HTN crisis, pregnancy), licensed 1936
- Novel antivenom reduced pain more rapidly (2013)
- Narcotics and Benzodiazepines
- Tetanus prophylaxis
- No prophylactic antibiotics
- Hospitalization for pain control



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Loxosceles Epidemiology

- Greek, secret biter
- Transported in freight
- 13 species most common Midwest & Southern U.S.
- Pacific Northwest, Tegenaria Agrestis
- Necrotic Arachnidism 1957
- Both sexes, reclusive, spring and summer

Loxosceles Pathophysiology

- Local reaction much more common than systemic reaction
- Less than 10% form ulcerative lesions
- Burning within 60 minutes
- Gradual progression: Blister formation => central ischemic ring (surrounded by erythema) => bleb formation (hemorrhagic) and finally rupture
- Bleb ruptures and forms central necrotic lesion



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Loxosceles Pathophysiology

- Necrosis more common on abdomen, thigh, and buttock
- Systemic effects are rare
 - arthralgias, fever, nausea, and rash (scarlatina-form like) and regional adenopathy

Loxosceles Treatment

- Tetanus prophylaxis
- Wound cleansing
- Antihistamines
- Analgesics
- Hyperbaric Oxygen (HBO) ?

Venomous Snakes International Epidemiology

- Estimated 300,000 to 400,000 venomous snakebites per year worldwide
- Estimates of deaths each year from snakebite range from 30,000 to 110,000 worldwide

US Data

- 4,000 to 6,000 venomous snakebites occur each year in US
- US mortality with the administration of antivenin is 0.28%
- Without antivenin administration mortality is approximately 2.6%
- Before antivenom and modern support death rate ~ 25%

Exotic Imports – Thriving Business



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Crotalidae Epidemiology

- Age extremes at risk
- Alaska, Maine, and Hawaii
- Southwest and Southeast
- Extremities, male, provoked, alcohol
- May to October

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Crotalidae Envenomation

- Science versus Chart review
- Are recommendations based on speculation and anecdote ?
- Strike completed in 0.5 seconds
- 25% of all bites are “dry bites”
- Age of reptile does influence amount of venom delivered



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Crotalidae Presentation

- Tissue injury - metalloproteinase
 - Edema, blebs, lymphangitis (persistent edema, life-long)
 - Local skeletal muscle breakdown (rhabdomyolysis, bad for kidneys)
- Coagulopathy - thrombin-like enzyme and phospholipase
 - Defibrinogenation, thrombocytopenia, DIC, and anemia
 - Destruction of cells and lack of clotting factors



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Crotalidae Presentation

- Hypovolemia
 - Third spacing into tissues, vomiting, hemorrhage
- Neurotoxicity - Mojave Rattlesnake
 - Tingling, paresthesia, muscle weakness, respiratory failure, and myokymia
- Miscellaneous
 - Nausea and vomiting, strange taste, numbness feeling, diaphoresis

Prehospital Treatment

- Support airway
- Establish intravenous access
- Remove jewelry including piercings if possible
- Remove tight fitting clothing

Prehospital Treatment

- Estimate time to definitive care
- Rapid transport
- Immobilize limb and calm patient
- NPO and obtain vascular access
- Mark the edema edge every 15 minutes



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Prehospital Treatment

- No heat application, electrical therapy, or cryotherapy
- Incision and suction (only in cowboy movies)
- Identification (capture not needed, use digital camera - phone)
- Lymphatic tourniquet – limit venom spread initially but increase myonecrosis
- Snake venom extractors (don't work)

Prehospital Treatment

- Med J Australia 1994 December
 - Lymphatic nuclear medicine flow rates
 - Firm limb bandaging
 - Strict limb immobilization
 - No ambulation
 - Elapidae species

History

- When did it occur?
- Previous exposures to venom &/or antivenin
- Medications & allergies

Grading the Envenomation

- Clinical course dictates when and amount antivenin. Need serial physical and lab exams.
- Grade I - mild: moderate pain, minimal edema, no systemic effects, labs normal
- Grade II - moderate: severe pain, edema and erythema, petechiae, weakness, fever, and vomiting

Grading the Envenomation

- Grade III - severe: widespread pain, edema 40 to 50 cm, ecchymosis, systemic signs
- Grade IV - very severe: rapid swelling, CNS dysfunction, shock



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F(AB) Fragments / Antidote

■ Indications

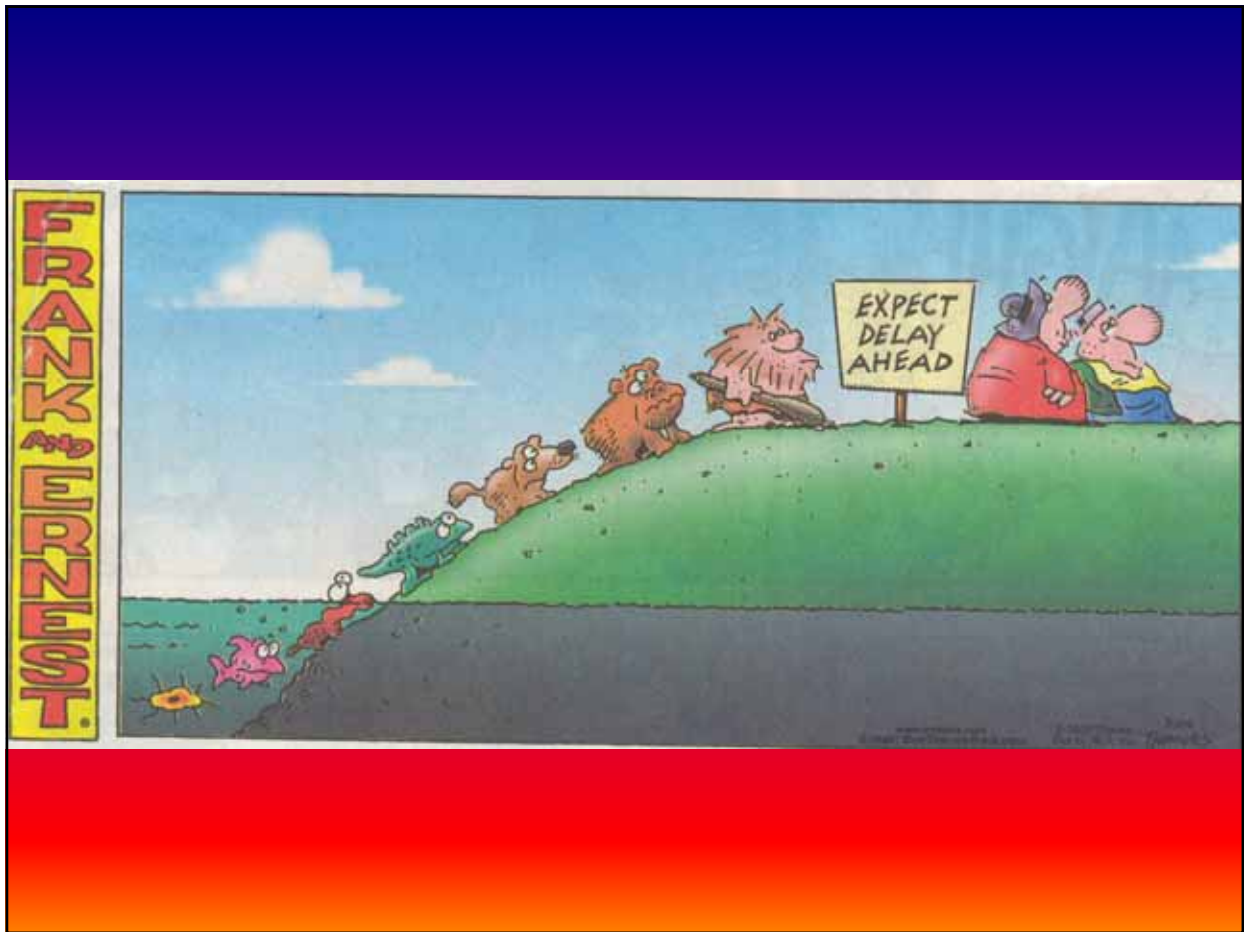
- Mild to Moderate envenomation
- Rapid progression of swelling
- Clinically significant coagulopathy including defibrination or thrombocytopenia
- Old antivenom (polyvalent) only moderate/severe envenomation
- Neuromuscular toxicity
- Shock

F(AB) Fragments / Antidote

- Most effective when given early
- First line treatment of coagulation disorders
- For mild and moderate envenomation
- Experimental antivenin (Antivipmyn)

Antibiotics

- No prophylactic antibiotics needed, venom thought to be antibacterial
- Tetanus prophylaxis



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Case Study 1 (1)

- 58 year old woman
- Call Type: Anaphylactic Reaction
- PSAP 13:21
- Unit Dispatched 13:21
- En Route 13:22
- At Scene 13:23
- Depart Scene 13:41
- Arrive Destination 13:55

Case Study 1 (2)

- Chief Complaint: SOB secondary to bee sting for 5 minutes
- Medications: Prinivil
- Past Medical History: Hypertension

Case Study 1 (3)

- Patient sitting position
- 13:24 Chest/Lungs: Normal chest assessment, increased effort, expiratory and inspiratory wheezing
- 13:26 initial vitals: BP 171/90, HR 143, RR 28, SpO2 100 low O2
- Monitor: Sinus tachycardia

Case Study 1 (4)

- Upon ambulance arrival on scene, patient found sitting upright in a chair, inside her home.
- Able to follow simple commands and is breathing heavily in obvious respiratory distress.
- Patient states was stung by a bee on her right hand approximately five minutes prior to ambulance arrival.

Case Study 1 (5)

- PMH of allergic reaction to bee stings and decided to call 911.
- Patient states she has an epi-pen but did not use it.
- Last time this happened, was given epinephrine but not get intubated.

Case Study 1 (6)

- Albuterol nebulizer 5 mg 13:25
- Benadryl 50 mg IM 13:28
- Venous access 13:39
- Cardiac monitor 13:54
- Normal Saline KVO 13:39

Case Study 1 (7)

- Physical Examination 13:25
- Mental Status normal for patient
- Skin: normal
- Neck: normal
- Chest/Lungs: Normal chest assessment, increased effort, expiratory wheezing, wheezes in the lower fields bilaterally, upper fields clear bilaterally

Case Study 1 (8)

- Abdomen: normal
- Extremities: normal
- Neuro: normal

Case Study 1 (9)

- Repeat vitals 13:46: BP 152/88, HR 105, SaO₂ 100 low O₂
- Patient states she feels “a little better” approximately 10 minutes after medication administration

Case Study 1 (10)

- Patient moved to gurney.
- En route to hospital patient monitored, treated and states “I feel normal now and can breath again”.

Case Study 2 (1)

- 66 year old male
- Call Type: Hazmat standby
- PSAP 20:24
- Unit Dispatched 20:24
- En Route 20:25
- At Scene 20:37
- Depart Scene 20:51
- Arrive Destination 21:05

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Case Study 2 (2)

- Chief complaint: snake bite and numbness in lips.
- History Present Illness: Patient states that he opened his back door and a snake fell from the above the door, out of some ivy that grows on the back of his house.
- Landed onto his foot and bit him on the right heel.

Case Study 2 (3)

- The injury site has obvious fang marks, and swelling around the injury site.
- Patient denies CP, SOB, headache, N/V, dizziness, LOC, blurred vision, or feeling light-headed.

Case Study 2 (4)

- Chest/Lungs: Normal chest assessment, normal and clear breath sounds
- Heart: Normal
- Extremities lower right: Pain/tenderness, + C.M.S., swelling/bruising/contusion with pain, motor function normal, normal pulse, sensation normal, 1 inch circular swelling and redness around site of snake bite.

Case Study 2 (5)

- Vitals (per Fire First Responder) PTA:
BP148/96, HR 96, RR 20
- Monitor 20:48 Normal Sinus Rhythm
- 20:50 SaO2 99% room air
- 20:41 Pain measurement positive, to right heel at snake bite

Case Study 2 (6)

- 20:42 Neuro: Normal
- Head/Face: Symmetric face, numbness to lips and tongue
- Neck: Normal
- Chest/Lungs: Normal chest assessment, normal, clear, and equal breath sounds

Case Study 2 (7)

- 20:49 Venous access, left forearm
- 20:49 Normal Saline, KVO rate
- 20:58 Vitals: BP 152/98, HR 91, RR 20, SaO₂ 98% on room air
- 21:04 Monitor: Normal Sinus Rhythm, no ectopy

Case Study 2 (8)

- There was approximately 1 inch swelling around bite site at 20:38
- The patient had no change in pain level during transport.
- Increased numbness to his lips and no more numbness to the tongue.
- The swelling increased during transport.
- The patient's extremity was kept dependent of his heart.

Case Study 2 (9)

- At the time of transfer of care to emergency physician, the swelling had increased to approximately 2 inches around the site.
- The snake was killed by animal control and the head and body of the snake were transported in separate bags for evaluation by emergency department staff.

Case Study 3 (1)

- Call Type: Traumatic Injury
- PSAP: 14:48
- Unit dispatched: 14:48
- En route: 14:48
- At scene: 14:49
- Depart scene: 15:09
- Arrive destination: 15:35

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Case Study 3 (2)

- Chief complaint: Dog bite to face and throat
- Is the scene safe?
- 15:29
- Head/Face: Pain/tenderness, bleeding controlled, laceration, puncture wounds
- Neck: Bleeding controlled, laceration

Case Study 3 (3)

- Vitals 15:09 BP 122/77, HR 79, RR not documented, SaO₂ 100%
- 14:51 ALS assessment
- 14:51 GCS 15

Case Study 3 (4)

- Does patient meet trauma triage criteria?
- Anatomic: Penetrating injuries to head and neck
- Paramedic discretion

Case Study 3 (5)

- 15:29
- Mental status: Normal
- Neuro: Normal
- Pupils: Reactive
- Chest/Lungs: Normal chest assessment, normal clear breath sounds and equal

Case Study 3 (6)

- Abdomen (LUQ, LLQ, RUQ, RLQ):
Normal
- Cervical, Thoracic, Lumbar: Normal and no
pain
- Extremities: Normal

Case Study 3 (7)

- 15: 02 Oxygen by nasal cannula 4 LPM
- 15:10 Monitor: Normal Sinus Rhythm, no ectopy
- 15:11 HR 74
- 15:14 Venous access left antecubital
- 15:14 Normal Saline KVO
- 15:15 Blood Glucose analysis 127

Case Study 3 (8)

- Patient admits to alcohol and drug use
- PMH: Cardiac
- Medications: none
- 15:21 HR 67

Case Study 3 (9)

- 25 year old female with dog bites to face and throat.
- Upon arrival patient was ambulatory to Fire Department apparatus tailboard.
- Patient states that her dog who is half dingo and half lab bit her in the face while having an argument with her husband.

Case Study 3 (10)

- Patient has full thickness lacerations thru cheek area, and a 4 inch long horizontal laceration across her throat at the larynx area with fatty tissue exposed.
- Patient's bleeding controlled prior to EMS arrival with bandages.
- Patient states slight shortness of breath upon assessment.

Case Study 3 (11)

- Patient transported code 2 to nearest trauma center as trauma patient.
- 15:33 BP 186/148, HR 71, SaO₂ 100% on 4 LPM.
- Patient was off loaded at 15:36



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