Disclosures

• We have no relevant financial relationships to disclose

• We do not plan to discuss unapproved, experimental, investigatory, or off-label drug usage.
Learning Objectives

1. Recognize and manage:
   • Snakes and envenomations
   • Spiders and lactroductism and loxoscelism
   • Illnesses from rat, bat, dog, cat and human bites

2. Have some fun with it

Definitions

• Venomous – animal introduces toxin to victim by bite or sting
  • Snakes, hymenoptera, spiders, scorpions, lionfish

• Poisonous – animal is toxic when it is ingested
  • Puffer fish, common quail depending on diet
Snakes!
“Why’d it have to be snakes??”

Which of these snakes is venomous?

A. 

B. 
Epidemiology of Venomous Snake Bites in the US

- Estimated 9000 ED visits/year
  - About 1/3 of those venomous (mostly pit vipers)
  - Usually provoked
  - 5-6 deaths/year
- Hard to know true incidence
Pediatric Epidemiology

- Average of about 1330 reported bites/year
- Half from rattlesnakes and copperheads
- Boys/men more common
  - Also more likely to be bitten in upper extremities than girls/women
- Average age 10-11y
- Reported deaths are rare
- Summer most common, but year-round

Rates of venomous snakebites per 1 million Population
According to state, Ages 0 to 18 years, 2000 to 2013
Venomous snakes in the US and Canada

- Crotalids (pit vipers)
  - Most common venomous snakes in US and Canada

Rattlesnakes
- approximately 32 different species

Water moccasin/
- Cottonmouth
  (Agkistrodon piscivorus)

Copperhead
- (Agkistrodon conotortrix)

Venomous vs Nonvenomous Snakes

- Characteristics of Pit Vipers

- Caveats
  - No one distinguishing feature
  - Common characteristics not applicable to all snakes
  - Nonvenomous snakes can mimic findings
  - Does not apply to snakes outside of US/Canada
  - Consultation with expert best way to identify
Venomous vs Nonvenomous Snakes

Effects of Crotalid Venom

- Local toxicity: soft tissue necrosis and inflammation
  - Pain, redness, progressive swelling
  - Tissue and muscle necrosis
  - Begins at bite site and spreads through lymphatic system
Effects of Crotalid Venom

• Local toxicity

• Hematologic
  • Coagulopathy
    • Prolonged coagulation studies
    • Decreased fibrinogen
    • Thrombocytopenia
  • Clinical signs
    • Local ooze at bite site
    • Surrounding ecchymoses
    • Severe bleeds/DIC possible

Effects of Crotalid Venom

• Local toxicity

• Hematologic

• Systemic
  • Hypotension
  • Nausea/vomiting
  • Third spacing
  • Neurotoxicity
    • Seizures, altered mental status
    • Metallic taste in mouth
    • Fasciculations/myokymia
Crotalid Envenomation: Special Cases

- Mojave rattlesnake (*Crotalus scutulatus*) and Southern pacific rattlesnake (*Crotalus oreganus helleri*)
- Rhabdomyolysis
- “Dry bites”

Management of Crotalid Envenomations

- Variable presentations → variability in management
  - Severity of a bite can change over time
  - Antivenom is expensive
    - $6632.40 for 2 vial package

- 2011 national guideline published
Hospital Management

- Good history to identify snake
- Supportive care
  - ABCs
  - Remove constrictive clothing and jewelry
  - Keep joints in relative extension
  - Frequent vital sign monitoring
- Tetanus

Hospital Management

- Supportive care
- Labs
  - CBC
  - Coagulation studies
  - CMP
  - Fibrinogen
Hospital Management

• Supportive care

• Labs

• Pain control
  • Morphine
  • Avoid NSAIDs

• Wound Care
  • Local debridement of wounds/blisters
  • Surgical debridement not recommended

Photo credit: Eric C. Soehren
www.outdooralabama.com

Hospital Management

• Supportive care

• Labs

• Pain control

• Wound Care

• Antibiotics
  • Empiric antibiotics not recommended
  • Secondary infection not common but possible

Photo credit: Eric C. Soehren
www.outdooralabama.com
Physical Exam

Measurement Instructions:
Keep the affected extremity elevated to the heart level. Do NOT allow the extremity to remain dependent.

- Mark skin with a skin marker near the bite site.
- Mark skin proximally every 5cm for at least 25cm.
- Label each mark with a letter so that multiple providers can consistently and objectively record the same area.
- Assign a letter after the mark record keeping.
- Record circumferential measurements on this page or somewhere in the medical record.

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crotalidae Polyvalent Immune Fab (CroFab®)

- Only pit viper antivenom in US
- Contains the Fab portion of antibodies to 4 species
- Half life is shorter than Crotalid venom
- Post treatment coagulopathy & bleeding possible
- Expensive
Indications for Treatment

• Systemic signs

• “Progressive” exam findings

• Hematologic abnormalities

• Not necessarily indicated with only local pain and swelling

Dosing of Crotalid Antivenom

• Initial dose: 4-6 vials
  • Larger doses for critically ill patients can be considered
  • Reassess after 1hr for effect
  • Continue 4-6 vials if
    • Exam findings still progressing OR
    • Labs aren’t getting better
  • Muscle fasciculations can continue despite antivenom
Dosing of Crotalid Antivenom

• Initial dose

• Initial control
  • Swelling has stopped progressing
  • Labs stabilizing

• Maintenance dosing
  • 2 vials q6hrs x 3
  • Try to prevent recurrent effects/delayed onset
  • Controversial if indicated for everyone
  • Risk varies by initial presentation and type of species
  • Observe with serial exam and labs for signs of recurrence
Dry Bites and Minor Envenomations

• Dry bite
  • No signs of envenomation
  • Antivenom not indicated
  • Observe for delayed symptoms

• Minor envenomation
  • Local tissue effects only
  • Antivenom not recommended
  • Admit and observe for progression
  • How long?

Discharge Criteria

• Exam: no progression

Labs:
  • Normal OR
  • Resolving hematologic abnormalities

• Adequate pain control
• Good follow up

Home Management
Discharge Criteria

• Exam: no progression
• Labs:
  • Normal OR
  • Resolving hematologic abnormalities
• Adequate pain control
• Good follow up

Home Management

• Monitor for worsening swelling
• If antivenom given
  • Monitor for serum sickness (5-10%)
• Activity restrictions
  • No contact sports
  • No elective surgeries
  • No dental work
  • May need follow up labs

Special Situations

• Head/neck bites
  • Consider intubation
Special Situations

• Head/neck bites
  • Consider intubation

• Allergy/anaphylactoid reactions
  • Stop infusion
  • Antihistamines, steroids, epi if needed
  • Consult toxicology

• Rhabdomyolysis
  • Rare with US pit vipers
  • Consider with severe local tissue injury or prolonged neurotoxicity
Compartment Syndrome and Fasciotomy

Don't perform fasciotomy in patients with snake envenomation absent direct measurement of elevated intracompartmental pressures.

Elapids: Coral snakes

- Much rarer
- Related to cobras and mambas with similar venom effects
- 3 species in US
  - Arizona or Sonoran coral snake (*Micruroides euryxanthus*)
  - Texas coral snake (*Micrurus tener*)
  - Eastern coral snake (*Micrurus fulvius*)
Venomous vs Nonvenomous Snakes: Coral Snakes vs King Snakes

Elapids: Coral snakes

- Primarily neurotoxic venom
- Local effects are minimal
- Systemic effects can be delayed by several hours and persist for weeks

Neurologic symptoms include
- Bulbar symptoms
  - Ptosis, diplopia, dysphagia, tongue fasiculations
- Altered mental status
- Salivation, diaphoresis
- Neuromuscular weakness
- Respiratory failure
Treatment: Coral Snake Envenomation

• Supportive care

• North American Coral Snake Antivenin
  • No longer being manufactured
  • FDA extended expiration to January 31, 2018
  • Local Poison Control can help with obtaining OR
  • Call manufacturer directly

• Treatment approach varies
  • Empiric treatment
  • Wait until symptoms begin
  • Retrospective data showing no worse outcomes with withholding treatment
  • Consult with expert

Basilisks

FUN BASILISK FACTS
(Fact #1: can be found in a toilet)

Yellow eyes kill instantly if looked at directly.
Ultra-poisonous venom. The only cure? Makin’ a Phoenix cry on you.
Sheds (kinda like a puppy!)

Spiders

“Why spiders? Why couldn’t it be follow the butterflies?”

Which of these spiders is a brown recluse?

A. 
B. 
C. 
D. 

https://api.cvent.com/polling/v1/api/polls/spurtpb5
Spiders

• Important cause of occupational injury and time away from work
• 20,000 venomous spider types
• 2 main types
  • *Lactrodectus* - Widow spiders
    • Neurotoxic syndrome
  • *Loxosceles* - Fiddleback or Recluse spiders
    • Tissue necrosis
Neurotoxic Spiders

• *Latrodectus* spp
  • Widow spiders
    • *L. mactan* (southern widow)
    • *L. hesperus* (western widow)
    • *L. variolus* (northern widow)

• Other, less important to us
  • *Atrax* spp and *Hydranyche* spp
    • Funnel web spiders of Australia
  • *Phoneutria* spp
    • Banana spiders of Latin America
  • Brown widow spiders *Latrodectus geometricus*
    • Non-native
    • Not medically significant
**Latrodectism**

- Venom acts at neural synapses
- *Latrodectus spp* have very similar venoms
  - Mainly Alpha-latrotoxin
- **PAINFUL**
- **Systemic effects**
  - Nausea, vomiting, headache
  - Hypertension
  - Tachycardia/Bradycardia
  - Hypersalivation
  - Diaphoresis
  - Diffuse muscle spasms

**Management**

- Supportive care
- Pain control and benzodiazepines as needed
- May take 72 hours to improve
Management

• Supportive care
• Pain control
• Antivenom for unstable patients only
  • 1 vial IM or IV
  • Relief in ~30 minutes
  • Risk of anaphylaxis outweighs benefit in mild to moderate cases

Most patients can be discharged from the ED
Necrotizing Spiders: Brown Recluse

6 eyes arranged in pairs
Most spiders have 8 eyes
One pair in front and a pair on either side

No spines, only fine hairs
Abdomen pale brown to cream, uniformly colored

Dark violin shape on cephalothorax

3/8 inch

Recluse Spiders

Range of recluse (genus Loxosceles) spiders in the United States
Loxoscelism

- Many spiders can cause some local tissue damage
- *Loxosceles* species are notoriously the most dermonecrotic
- Sphingomyelinase D
- Often PAINLESS
- Misdiagnosis of bite is common

Venom and Effects

- 1st few hours – focal ischemia
**Venom and Effects**

- **1st few hours** – focal ischemia

- **Within 24 hours**
  - Central clear or blood filled vesicle
  - Surrounding ecchymosis
  - Rim of pale ischemia
  - “Red, white, blue” or bulls-eye lesion

- **24 hours** – local lesion
  - Expands over days to weeks
  - Necrotic tissue sloughs
  - Healing begins
Venom and Effects

- 1st few hours – focal ischemia
- 24 hours—local lesion
- Expands over days to weeks

**Systemic effects**
- Rare, but more common in young children
- Fever, chills
- Nausea
- Malaise
- Diffuse macular rash
- Petechiae, hemolysis, coagulopathy
- Renal Failure

Conditions Potentially Misdiagnosed as Brown Recluse Bites

- Atypical Mycobacterium Infection
- Staphylococcal, Streptococcal, Lyme disease, cutaneous anthrax, syphilis,
- Gonococcemia, rickettsial disease, tularemia
- Ecthyma gangrenosum
- Environmental pathogen infections (*Chromobacterium*)
- Leishmaniasis
- HSV, Herpes Zoster
- Vascular occlusive or venous disease
- Necrotizing Vasculitis (Wegener’s, Takayasu arteritis, PAN, etc.)
- Leukemia cutis, lymphoma (mycosis fungoides) and skin neoplasms
- Chemical, thermal, or traumatic injuries, factitious Injuries
- Rhus dermatitis, pressure ulcers and diabetic ulcers
- Radiotherapy, septic embolism and many others
Management

• Supportive care of the necrotizing area
  • Intermittent local ice therapy for 72 hours
  • No definitive effective treatment or antivenin

• Daily wound cleansings, wound checks & splint area
  • Repeat until healed

• Medications
  • Antibiotics for any secondary bacterial infection
  • No role for steroids, metronidazole, diphenhydramine or cyproheptadine
  • Dapsone has not been proven efficacious in prospective trials
    • Can induce hemolysis or methemoglobinemia

• Trials of local electric shock and excision and grafting have mixed results
Hospital Management

- Admit children with systemic symptoms
  - Monitor for hemolysis and coagulopathy
  - Obtain CBC, coagulation studies and urinalysis
- IV hydration
- Manage renal failure as needed
- Brief steroid course to stabilize RBC membrane
- No fatal cases documented in the USA
  - South American violin spider (L. laeta) can be fatal

Tarantulas

- Often gentle but when provoked will bite
- Fangs can produce painful puncture wounds
- Abdominal hairs act to discourage predators
  - Can cause itching, burning and rash
  - Remove with tape
- Bites are unlikely to cause problems other than pain at the site
  - Venomous species exist outside the USA
- Clean with soap and water
- Risk of tetanus
Mammals!

Rats

“Rodents of unusual size? I don’t think they exist.”
Family Muridae

• Subfamily: Murinae
  • Genus: Rattus
  • Size matters

Rat Bites

• Healthy rats avoid people and like quiet buildings
• Bite when threatened
• No rabies in North America
• Infection is rare
• Think about tetanus
Clinical Presentation

• Bites shallow or deep; puncture or abrasion
• Common symptoms
  • Pain
  • Erythema
  • Edema around the bite

Directly Transmitted

Through feces, urine, or bites
• Hantavirus Pulmonary Syndrome
• Hemorrhagic Fever with Renal Syndrome
• Lassa Fever
• Leptospirosis
• Lymphocytic Chorio-meningitis (LCM)
• Omsk Hemorrhagic Fever
• Plague
• Rat-Bite Fever
• Salmonellosis
• South American Arenaviruses
  • Argentine hemorrhagic fever
  • Bolivian hemorrhagic fever
  • Sabiá-associated hemorrhagic fever
  • Venezuelan hemorrhagic fever
• Tularemia

Indirectly Transmitted

Rats and Mice Spread Over 35 Diseases Worldwide
Rats and Mice Spread Over 35 Diseases Worldwide

Directly Transmitted
Through feces, urine, or bites
• Hantavirus Pulmonary Syndrome
• Hemorrhagic Fever with Renal Syndrome
• Lassa Fever
• Leptospirosis
• Lymphocytic Chorio-meningitis (LCM)
• Omsk Hemorrhagic Fever
• Plague
• Rat-Bite Fever
• Salmonellosis
• South American Arenaviruses
  • Argentine hemorrhagic fever
  • Bolivian hemorrhagic fever
  • Sabia-associated hemorrhagic fever
  • Venezuelan hemorrhagic fever
• Tularemia

Indirectly Transmitted
Through ticks, mites, or fleas
• Babesiosis
• Colorado Tick Fever
• Cutaneous Leishmaniasis
• Human Granulocytic Anaplasmosis
• La Cross Encephalitis
• Lyme Disease
• Murine Typhus
• Omsk Hemorrhagic Fever
• Powassan Virus
• Rickettsial pox
• Relapsing Fever
• Rocky Mountain Spotted Fever
• Scrub Typhus
• Sylvatic Typhus
• West Nile Virus

Rat Bite Fever

#RBF
Rat Bite Fever

- Spread by rats
- Transmission
  - Bites or scratches
  - Handling rodents with the disease
  - Consuming contaminated food or drink (Haverhill fever)
- Occurrence rates unknown

1. Streptobacillary
   - *Streptobacillus moniliformis*
   - North America and Europe

2. Spirillary RBF (Sodoku)
   - *Spirillum minus*
   - Asia and Africa
Streptobacillary RBF Clinical Manifestations

• 3-10 days after exposure
  • Can be delayed
• Fever
• Vomiting
• Headache
• Myalgia and arthralgia

Maculopapular rash
• 2-4 days after fever
• Hands and feet
• Joint pain, edema, erythema
  • Follows rash
Streptobacillary RBF Outcomes

- Without treatment
  - Endocarditis
  - Myocarditis
  - Meningitis
  - Pneumonia
  - Sepsis

- Mortality rate 7%-13%

Rat Bite Fever Diagnosis

- Suspicion in patients with symptoms + exposure

- *S. moniliformis*
  - From blood, synovial fluid, or other body fluids
  - Difficult to grow in culture

- Identifying pleomorphic gram-negative bacilli supports diagnosis
Rat Bite Fever Treatment

[Image of a bottle of penicillin]

Hantaviruses
Hantaviruses

• Hantavirus pulmonary syndrome
  • Noncardiogenic pulmonary edema
• Hemorrhagic fever with renal syndrome

HPS Cases by State of Exposure

Cumulative Case Count Per State as of 1/8/16
HPS Mechanisms of Spread

• Direct contact with
  • Infected rodents
  • Droppings
  • Nests

• Inhalation of aerosolized virus particles from
  • Urine
  • Droppings
  • Saliva

• Rarely through bites

Hantavirus Pulmonary Syndrome

• Incubation period 1-6 weeks, not clearly established

• Prodrome 3-7 days
  • Fever
  • Chills
  • Headache
  • Myalgias (shoulders, back, thighs)
  • Nausea, vomiting, diarrhea
  • Dizziness
  • Sometimes cough
Hantavirus Pulmonary Syndrome

• Incubation period 1-6 weeks
• Prodrome 3-7 days
• Respiratory symptoms
  • Start after first 3-7 days
  • Pulmonary edema and severe hypoxemia
  • Appear abruptly and progress over hours

Hantavirus Pulmonary Syndrome

• Incubation period 1-6 weeks
• Prodrome 3-7 days
• Respiratory symptoms
  • Diffuse pulmonary capillary leak
    • Extensive alveolar pulmonary edema
    • Pleural effusions
    • Requires mechanical ventilation for 2-4 days, then onset of diuresis and rapid clinical improvement
Hantavirus Pulmonary Syndrome

• Incubation period 1-6 weeks
• Prodrome 3-7 days
• Respiratory symptoms
• Diffuse pulmonary capillary leak
• Severe cases: Myocardial involvement → Hypotension
• Mortality rate 30-40%
• No sequelae in survivors

HPS Diagnosis

• Clinical
  • Tough—early symptoms look like flu
  • Shortness of breath
  • History of exposure important
HPS Diagnosis

• Clinical
  • Shortness of breath

• Diagnostic testing
  • PCR
  • Hanta-specific IgM and IgG antibodies
  • Enzyme immunoassay

HPS Treatment

• Transfer immediately to a tertiary care facility
  • First 24-48 hours
  • Early care predicts better prognosis

• Supportive care
HPS Treatment

• Transfer to tertiary care facility
• Supportive care
• For severe disease
  • Early mechanical ventilation and pressor support
  • Consider ECMO

HPS Treatment

• Transfer to tertiary care facility
• Supportive care
• Ribavirin
  • Active in vitro against hantaviruses, including SNV
  • Not yet shown to be effective in cardiopulmonary stage
Lymphocytic Choriomeningitis Virus

• Carried by house mouse (*Mus musculus*)
  • 5% of house mice in US carry LCMV
  • Other rodents

• Disease occurs worldwide

https://www.orkin.com/rodents/house-mouse/
**Lymphocytic Choriomeningitis Virus**

- **Transmission**
  - Inhaling dust contaminated with urine or droppings
  - Direct contact
  - Bite wounds, not frequent
- **Risk of exposure**
  - Owners of pet mice or hamsters
  - Human fetuses from mother
  - Lab workers who handle animals

**Lymphocytic Choriomeningitis (LCM) Clinical Manifestations**

**Initial Phase**

- up to 7 days

- **Common**
  - Fever
  - Malaise
  - Lack of appetite
  - Muscle aches
  - Headache
  - Nausea and vomiting

- **Less frequent**
  - Sore throat
  - Cough
  - Joint pain
  - Chest pain
  - Testicular pain
  - Parotid pain
LCM Clinical Manifestations

**Initial Phase**
- up to 7 days

**Recovery**
- few days

**Second Phase**
- Meningitis
- Encephalitis
- Meningoencephalitis
- May cause
  - Acute hydrocephalus
  - Surgical shunting
  - Myelitis
  - Myocarditis

LCM Outcomes

- Mortality is <1%
- No chronic infection
- Virus clears after acute phase of illness
- Neurological damage is possible secondary to CNS infection
LCM Fetal Infection

• 1\textsuperscript{st} Trimester
  • Can result in fetal death

• 2\textsuperscript{nd} and 3\textsuperscript{rd} Trimesters
  • Chorioretinitis
  • Structural brain abnormalities

LCM Diagnosis

- **Initial Phase**
  - Leukopenia, thrombocytopenia, mild elevation of liver enzymes
  - Can detect with PCR of CSF

- **Recovery**

- **Second Phase**
  - CSF with increased protein and WBC; +/- decrease in glucose

**Laboratory diagnosis:**
- IgM and IgG antibodies in CSF and serum
LCM Treatment

• Based on severity
• Hospitalization and supportive treatment
• Consider corticosteroids
• Ribavirin
  • Effective in vitro
  • No evidence to support its routine use

Plague—Not a bite, but Important
Plague in the US

Reported cases of human plague--United States, 1970-2012

Human plague cases and deaths--United States, 2000-2015

1 dot placed in county of exposure for each plague case

Plague Ecology in the United States

Plague in Nature
Plague occurs naturally in the western U.S., especially in the semi-arid grasslands and scrub woodlands of the southwestern states of Arizona, Colorado, New Mexico and Utah.

Plague in Humans
Occasionally, infections among rodents increase dramatically, causing an outbreak, or epizootic. During plague epizootics, many rodents die, causing hungry fleas to seek other sources of blood. Studies suggest that epizootics in the southwestern U.S. are more likely to occur during cooler summers that follow wet winters.

The plague bacterium (Yersinia pestis) is transmitted by fleas and cycles naturally among wild rodents, including rock squirrels, ground squirrels, prairie dogs and wood rats.

Humans and domestic animals that are bitten by fleas from dead animals are at risk for contracting plague, especially during an epizootic. Cats usually become very ill from plague and can directly infect humans when they cough infectious droplets into the air. Dogs are less likely to be ill, but they can still bring plague-infected fleas into the home. In addition to flea bites, people can be exposed while handling skins or flesh of infected animals.
Plague Clinical Manifestations

• Bubonic plague
  • Swollen, tender, painful lymph nodes (buboes)
• Septicemic plague
  • Fever, abdominal pain, shock
  • Bleeding into skin, necrosis
• Pneumonic plague
  • Rapidly developing pneumonia
  • Only form that can be spread person to person

https://www.cdc.gov/plague/symptoms/index.html

Treatment

• Gentamicin or streptomycin IM/IV
• Chloramphenicol = DOC for meningitis
• Drainage of buboes

Prophylaxis

• Transmission occurs with hemoptysis
• Everyone exposed in last 6 days

http://www.tombanwell.com/plague-doctor-masks-etc/
Bats

“Why bats, Master Wayne?”
“Bats frighten me. It’s time my enemies share my dread.”

Bat Bites

• Rarely have classic bite marks
  • Brown bats have sharp tiny teeth
  • May be an abrasion
• Vampire bats are not found in the US
Bats Transmit Disease

- Rabies
- Histoplasmosis
  - Lung disease primarily
  - Fungus grows in soil, bat droppings
  - Caves
  - Treat with antifungals
- Marburg hemorrhagic fever
  - Fruit bats in Uganda
- Nipah virus encephalitis
  - Fruit bats in Southeast Asia, Africa
- Hendra virus disease
  - Fruit bats in Australia
- Coronaviruses, maybe including SARS

Rabies

- RNA virus: *Rhabdoviridae* family, *Lyssavirus* genus

**Incubation period**
- 1-3 months
- Ranges days to years

**Acute onset**
- Consider in DDx of acute encephalitic illness with features of Guillain-Barre syndrome

**Rapidly progressive CNS disease**
- Anxiety
- Radicular pain
- Dysethesia or pruritis
- Hydrophobia
- Dysautonomia
- +/- Paralysis

**Death (universal)**
Rabies Epidemiology

• Human infections → in US since 1950s
  • Dog immunization
  • PEP

• Almost all cases are associated with bats

• No person to person transmission in US, though virus is in saliva

Rabies Epidemiology

• Virus is in saliva, transmitted by bites

• Wildlife

• Domestic animals
Rabies Epidemiology

• Most important wildlife
  • Bats
  • Raccoons
  • Skunks
  • Foxes
  • Coyotes
  • Bobcats

• Hawaii is the only state without wildlife rabies

Rabies Epidemiology

• Domestic animals
  • Dogs, cats, and ferrets
  • Shed virus for a few days before symptomatic
  • Held for 10 days of confinement

• Worldwide, dog bites #1 cause of rabies
Rabies Diagnosis

• Call health department

• Antemortem
  • DFA test on skin biopsy
  • Isolation of virus in saliva
  • Antibody in serum of unvaccinated people
  • Antibody in CSF of anyone
  • Detection of viral nucleotide sequences in saliva, skin, or other tissues

• No single test is sufficiently sensitive

• Postmortem
  • Brain tissue
Rabies Treatment

Rabies Prevention

• Exposure
  • Break in skin by teeth of rabid animal
  • Contamination of scratches, abrasions, or mucous membranes

• In the US, all mammals are considered susceptible
  • Bats, raccoons, skunks, and foxes are more likely to be infected

• Other factors to consider
  • Provoked or unprovoked attack
Rabies Care of Exposed People

• Local wound care
  • Flush thoroughly and clean with soap and water
  • Avoid sutures

• Prophylaxis
  • Passive and active prophylaxis
  • Begin as soon as possible after exposure, within 24 hours
  • Give even if days later

Rabies Post-exposure Prophylaxis: Who gets?

• Bites
  • Contamination with rabid animal saliva

• May be indicated if bat is in the same room
  • Bat bite or scratch may not leave much injury
  • Sleeping person or unattended child

Rabies Post-exposure Prophylaxis

Active Immunization
- HDCV or PCECV
- 1mL IM Deltoid (or thigh)
- Day 0,3,7,14, (± 28)
- Give even if RIG not available

Passive Immunization

Post-Exposure Prophylaxis
**Rabies Post-exposure Prophylaxis**

**Active Immunization**
- HDCV or PCECV

**Passive Immunization**
- RIG
  - 20 UI/kg—1 dose day 0
  - Infiltrate as much into wound as possible
  - Rest into the other deltoid
  - Dilute for multiple wounds
  - Bridges b/t exposure and response to vaccine

**Post-Exposure Prophylaxis**
Vampires

“Listen to them. Children of the night. What music they make.”

Vampires

• Recognizable features
  • Varies by region
  • Bloated, purplish, with longer fingernails and teeth
  • Attractive with fangs
  • Desire to drink human blood
  • Sensitivity to sunlight and garlic
  • May “sparkle” in the sun
Vampirism

• Transmission
  • Bite by another vampire
  • Traditionally
    • Infected wound
    • Witch when alive
    • Corpse jumped over by dog or cat

• Epidemiology
  • Predominantly Southeastern Europe
  • Malawi 2002-2003
  • Associated with TB and Plague epidemics

Vampirism

• Treatment
  • Stake through the heart (or mouth or stomach)
  • Decapitation

• Prevention
  • Place objects or grains at the grave
  • Sever tendons of corpses
  • Some protection from
    • Garlic
    • Wild rose and hawthorn plants
    • Crucifix, holy water
    • Mirrors
Dogs

“What counts is not necessarily the size of the dog in the fight; it’s the size of the fight in the dog.”

Which of these dog breeds is most likely to bite you?

A.  
B.  
C.  
Family Canidae

• Dogs *Canis lupus familiaris*

• Foxes *Vulpes sp.*

• Coyotes *Canis latrans*

• Wolves *Canis lupus, Canis lupus rufus*
Epidemiology

• 5 million animal bites yearly

• 90% dog bites (4.5 million)

• 1.8% require hospitalization

• Estimated $100 million in health care expenses and lost wages

• 10-20 deaths per year

Number of Dog Bite-Related Fatalities, by State, 1979-1996

*For 1979-1986, data obtained from the Humane Society of the United States registry, NEXIS database accounts, and death certificates. For 1995-1996, data from death certificates were not available.
Epidemiology

• Majority are 6-11 years old

• M:F 1.5:1

• 65% at home and 75% of animals are known

• 50% are unprovoked

• Some breeds have an elevated risk index

Rate on nonfatal dog-bite related injuries treated in U.S. hospital EDs by sex and age Group
National Electronic Injury Surveillance System-All Injury Program, United States, 2001

* Per 100,000 population.
Where do people get bitten?

Clinical Manifestations & Diagnosis

- Abrasions
- Puncture Wounds
- Laceration with or w/o tissue avulsion
Diagnosis

• Thorough history & physical
  • Circumstances of the bite
  • Drug Allergies
  • Immunization status (tetanus, rabies)
  • Type, size, depth
  • Presence of foreign material
  • Underlying structures, range of motion
  • Diagram of the injury

Diagnosis

• Radiographs
  • If penetrating injuries overlying bones or joints
  • For suspected fracture
  • To assess foreign body inoculation

• Face or head bites
  • Consider skull fracture or penetrating injuries
  • Especially in infants
  • Large animals
What part of the body is most likely to be infected (and experience the most morbidity) when bitten?

A. 
B. 
C. 

Insert Web Page

This app allows you to insert secure web pages starting with https:// into the slide deck. Non-secure web pages are not supported for security reasons.

Please enter the URL below:

https://apicvent.com/polling/v1/api/polls/esp-801qpr

Note: Many popular websites allow secure access. Please click on the preview button to ensure the web page is accessible.
Complications - Infection

- 80% have bacteria isolated in the first 8 hours
- Infection rate is only 2.5-20% if sought medical attention within 8 hours
- Wound culture when
  - Deep
  - Extensive
  - Contaminated
  - Early signs of infection at <8 hours
  - Immunocompromised (*Capnocytophaga canimorsus*)

Complications - Infection

- Risk increases with:
  - Hand, foot or genital wounds
  - Bone or tendon penetration
  - Delay in treatment >24 hours
  - Foreign material
  - Immunosuppression (asplenia)
  - Crush or deep puncture wounds
Microorganisms

- **Staphylococcus**
  - *S. aureus* 20-30%
  - *S. intermedius* - 25%
- **Streptococcus**
- **Eikenella**
- **Pasteurella**
  - *P. multocida* – 20-30%
- **Proteus**
- **Klebsiella**
- **Haemophilus**
- **Enterobacter**
- **DF-2 or Capnocytophaga species**
  - *C. canimorsus*
- **Bacteroides**
- **Moraxella**
- **Corynebacterium**
- **Neisseria**
- **Fusobacterium**
- **Prevotella**
- **Porphyromonas**

Treatment

- **Local wound care**
  - Anesthetize, clean, and irrigate
  - Blunt tip needle for puncture wounds
  - Debride
  - Incision and drainage as necessary
  - Closure is controversial
Treatment

• Local wound care

• Immobilize hand in functional position for 3-5 days

• Reevaluate within 24-36 hours!

Antibiotics

• Prophylaxis 3-5 days

• Treat infection for 7-10 days

• Amoxicillin-clavulanate or Ampicillin-sulbatam
  • Severity of the wound, infection, toxicity, and immune status
# Tetanus

## History of Tetanus Toxoid Doses

<table>
<thead>
<tr>
<th>Animal Bites</th>
<th>TIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP, Tdap, or Td</td>
<td></td>
</tr>
<tr>
<td>&lt; 3 or unknown</td>
<td>Yes</td>
</tr>
<tr>
<td>3 or more</td>
<td>No</td>
</tr>
</tbody>
</table>

### Notes:
- Yes if <5 y since last tetanus-containing vaccine dose.
- No if ≥5 y since last tetanus-containing vaccine dose.

Adapted from David W. Kimberlin, MD, FAAP; Michael T. Brady, MD, FAAP; Mary Anne Jackson, MD, FAAP; Sarah S. Long, MD, FAAP. Tetanus, Red Book® 2015 Committee on Infectious Diseases, American Academy of Pediatrics. [https://redbook.solutions.aap.org/chapter.aspx?sectionid=88187250&bookid=1484](https://redbook.solutions.aap.org/chapter.aspx?sectionid=88187250&bookid=1484)

---

## Reported Cases of Rabies in Dogs, by County, 2014

Foxes

Reported Cases of Rabies in Foxes, by County, 2014
Coyotes and Wolves

Coyotes

• Often the top predator
• Population ↑ing
• Commercial transport problem
• Avoid rabid reservoir animals
• Aggressive coyotes = 27.6 x more likely to be rabid

Wolves

• A top predator. Rabies less common
  • Similar to dog bites
• Wolf-human encounters in Canada and Alaska 1915-2001
  • 80 described encounters
  • 39 with aggression from healthy wolves
  • 12 confirmed to be rabid (15%)
• One big problem
On the next full moon.....

http://www.livescience.com/24412-werewolves.html
http://fangtasticfilm.blogspot.com/terrible-teen-wolf/
http://www.imdb.com/title/tt1595680/mediaviewer/rm3980449024

Treatment

Cats

“Cats make you work for their affection. They don’t sell out the way dogs do.”

Family Felidae

• Panthera
• Felinae
• Domestic Cats (*Felis catus*)

Photos courtesy of the Birmingham Zoo
Epidemiology

• Approximately 400,000 cat bites annually

• Most are on the upper extremities, provoked, and occur in adult women

• Can penetrate deeply with small surface wounds

• Infection rate 30-60%

• Hospitalization rate about 6%

Clinical Presentation

• Cellulitis and/or lymphangitis most common

• Purulent wounds with or without abscess

• Present with erythema, pain, and edema

• Can develop symptoms within 3 hours of initial bite
Pathogens

• Often polymicrobial

• *Pasteurella multocida* most common

• Other bacteria:
  • *Bartonella henselae*
  • *Staphylococcus spp, Streptococcus spp*
  • *Fusobacterium spp, Porphyromonas spp*
  • *Moraxella spp, Bacteroides spp*

Management

• Cleanse the wound and close only as needed

• Imaging for penetrating injuries over bones or joints

• Tetanus and rabies vaccines as needed

• Initiate antimicrobial prophylaxis for 3-7 days

• Follow up in 48 hours
Antimicrobial Therapy

• Amoxicillin-clavulanate is first line therapy

• PCN-allergic patients: extended spectrum cephalosporin or trimethoprim-sulfamethoxazole plus clindamycin

• If hospitalized: ampicillin-sulbactam or piperacillin-tazobactam

• Consider vancomycin for severe bite wounds to cover MRSA

Cat Scratch Disease: *Bartonella henselae*

• Transmission
  • Scratches
  • Licks or bites

• Clinical manifestation
  • Regional lymphadenopathy
  • Chronic skin lesions

• Diagnosis: serology

• Treatment: self limited
  • Azithromycin or doxycycline

https://redbook.solutions.aap.org/chapter.aspx?sectionId=88187117&bookId=1484&resultClick=24
http://iwastesomuchtime.com/on/?i=47619
Toxoplasmosis: *Toxoplasma gondii*

- **Transmission**
  - Ingestion of oocysts in cat feces

- **Clinical manifestation**
  - Acute lymphadenopathy
  - Hepatosplenomegaly
  - Fever

- **Diagnosis**
  - Serology, PCR

- **Treatment**
  - Pyrimethamine + sulfadiazine + folinic acid

---

**Brats (aka Humans)**

"Hell hath no fury like a toddler who wanted the green cup instead of the orange one."
Epidemiology

• Third leading cause of bite wounds

• Account for 3-23% of all bites

• Rough play in daycare or self-inflicted wounds more common

• Rate of infection 10-15%

• Hand bites most likely to develop severe morbidity

Clinical Presentation

• Occlusive bite
  • Similar to an animal bite
  • Typical elliptical or ovoid
  • Ecchymosis, abrasions, lacerations
  • Compression of tissue rather than avulsion
Clinical Presentation

• Occlusive bite

• Fight bite
  • Occurs when a fist hits a tooth
  • May cause significant morbidity from infection
  • Often delay in care due to benign appearance of wound
  • Can spread to deeper compartments of the hand

Bacterial Pathogens

• *Viridans streptococci, S. pyogenes*

• *Staphylococcus aureus, S. epidermidis*

• *Corynebacterium spp, Eikenella corrodens*

• Anaerobes
Viral Pathogens

• Hepatitis B and C
• HSV
• HIV

Management

• Cleanse the wound and close if indicated
• Imaging for penetrating injuries over bones or joints
• Tetanus vaccine as needed
• Assess risk of HBV and HIV
• Initiate antimicrobial therapy as indicated
• Follow up within 48 hours
Antimicrobial Therapy

• Initiate therapy for
  • Moderate or severe bite wounds, especially with edema or crush injury
  • Puncture wounds
  • Deep or surgically closed facial wounds
  • Hand and foot bites
  • Genital area bites
  • Wounds in immunocompromised and asplenic patients
  • Wounds with signs of infection

Antimicrobial Therapy

• Amoxicillin-clavulanate is first line therapy

• Penicillin-allergic patients: extended spectrum cephalosporin or trimethoprim-sulfamethoxazole plus clindamycin

• If hospitalized: ampicillin-sulbactam or piperacillin-tazobactam

• Consider vancomycin for severe bite wounds to cover MRSA
Zombies

• Transmission
  • Bites and other contact with bodily fluids

• Epidemiology
  • Eventually all humans will end up as zombies or dead

• Clinical Presentation
  • Slow movement, stumbling, stiff gait, violent tendencies

• Pathogens
  • Mutagenic gas or radiation, chemical powders, various viruses, prions

• Management
  • Quarantine and avoid contact

Which mammal bite is most likely to become infected?

A.  
B.  
C.  


https://lauricef.tumblr.com/post/35717857951/kitty-meme
Chew on This

• Snakes bite.
  • Call Poison Control early as not everyone needs antivenom.

• Spiders bite.
  • Not all that looks like a spider bite is. Supportive care is mainstay of therapy.

• Rats bite,
  • but their bodily fluids and parasites may be worse.

• Bats bite.
  • Rabies can be transmitted without a visible bite.

• Dogs bite.
  • Local wound care is most important.

• Cats bite.
  • Wound care is important, but antibiotics are key.

• Humans bite.
  • Location matters; seek treatment if the skin is broken.
Supplemental Information

Snake Bite Prevention

• Watch where step and place hands when outside

• Avoid walking in tall grass/thick brush

• Wear long pants/thick boots

• Wear gloves if handling brush/leaves

• If see a snake, give it space and leave it alone

“Knowledge of snake habits and appropriate avoidance measures, in addition to not deliberately antagonizing these animals, offers the most significant protection from unwanted exposure” – 2015 Wilderness Medical Society Practice Guideline
Spider Bite Prevention

• Inspect or shake out any clothing, shoes, towels, or equipment before use
• Wear protective clothing/gloves when handling stacked or undisturbed piles of materials
  • Check the gloves first for spiders, or stomp on the gloves
• Minimize the empty spaces between stacked materials
• Remove/reduce debris and rubble from around outdoor work areas
• Trim or eliminate tall grasses from around outdoor work areas
• Store apparel and outdoor equipment in tightly closed plastic bags
• Keep tetanus boosters up-to-date (every 10 years)
  • Spider bites can become infected with tetanus spores

Living with Brown Recluse spiders

• Use sticky traps to trap spiders
• Remove bed skirts, move bed away from wall and remove everything from under the bed
• Tape up edges of cardboard boxes
• Be careful when you move things out of storage areas, especially cardboard boxes
• Remove any spiders inside boxes using a vacuum cleaner and dispose of the bag
• Reseal all open edges of cardboard boxes with tape before restoring them
• Recluses love clutter and prefer to live under and between items
• Do not stack wood against the house
  • Stack it off the ground and cover it with a tarp
Dog Bite Prevention

- Evaluate your environment/lifestyle and consult professionals to decide on a breed
- Avoid having dogs with history of aggression if you have children
- Delay getting a dog if your child is fearful or apprehensive
- Spend time with a dog before owning one
- Seek professional advice for aggressive or undesirable behaviors
- Do not play aggressively with your dog
- Use caution with infants or toddlers with new dogs
- Never leave infants or children alone with animals
- Properly socialize and train your dog
- Spay/neuter your pets

Teach Children Basic Dog Safety

- Avoid direct eye contact
- Never approach an unfamiliar dog
- Never run from or past a dog
- Do not hug or kiss a dog
- Never play with a dog without an adult
- Let a dog see and sniff you before petting
- Tell adults about strays or unusual behavior in dogs
- Do not disturb if eating, sleeping or caring for pups
- Tell an adult if you are bitten
- Do not try to stop 2 fighting dogs; fighting dogs may bite anything
If an unfamiliar dog approaches you…

• Stop! Stay still like a tree. Be calm.
• Do not panic or make loud noises.
• Say "No" or "Go Home" in a firm, deep voice.
• Stand with the side of your body facing the dog.
  • Facing a dog directly can appear aggressive to the dog.
• Slowly raise your hands to your neck, with your elbows in.
• Wait for the dog to pass or slowly back away.

If you are attacked or bitten…

• Put your purse, bag, or jacket between you and the dog
• Stand still, feet together and protect neck and face with arms and hands
• Stand up
• If knocked over or attacked while lying:
  • Roll into a ball with your head tucked in
  • Place your hands over your ears and neck
  • Lie still and do not move
• Wash the area with soap and water once you are safe
• Seek medical attention
**Scorpion Stings**

- ~1200 species worldwide
- Most active at night, most bites are in summer
- Most only cause a painful sting
- Bark Scorpion (*Centruroides sculpturatus*)
  - 1 of 30 species in Arizona
  - Fatal cases have been documented but exceedingly rare
- Arizona and small areas of surrounding states

![Image](http://azpoison.com/en/scorpions)

**Epidemiology**

- Arizona Poison Control fields about 12k calls per year
- 95% handled outpatient
- ~250 patients per year require antivenin
- Risk groups are <2 years old, 2-6, and then 6 and above.
- One documented death on 2013
Pathophysiology

• Major components of venom are neurotoxins
• Alter neural membrane ionic channels
• Causes autonomic and cardiovascular dysfunction
• Releases **acetylcholine and catecholamines**
• Mild symptoms: mainly pain and paresthesias
  • Can be at the site or can travel away and come back to the site
  • May last weeks
Presentation

• Severe/systemic symptoms:
  • Muscle twitching → Uncontrollable, involuntary thrashing
  • Airway/Secretion issues
  • Roaming eye movements
  • Cranial nerve dysfunction
  • Opithotonus/emprosthotonos
  • Hypertensive crisis
  • Cardiovascular collapse
  • Respiratory failure

Management

• Contact local experts/poison control
• Clean the site with soap and water
  • Position/immobilize affected limb in a comfortable position
• Mild: NSAIDS and cold compresses/ice as an outpatient
  • For pain and paresthesias
• Severe:
  • ABC’s!!!!
  • Be cautious with opioids—may have synergy with scorpion bited
  • Benzodiazepines may be more helpful
  • Versed and fentanyl often used in intubated patients
  • Often extubate when thrashing stops (12-24 hours)
Antivenin - Anascorp

- FDA approved antivenin in 2011
- Centruroides (Scorpion) Immune F(ab)2 (Equine)
- Most patients improve within 2 hours
  - 98% of children treated had symptoms resolve in 4 hours
- Adverse effects:
  - Vomiting, fever, rash, nausea, itchiness, headache, runny nose, muscle pain
  - Trial of 1500 patients – 4% had vomiting
- Better tolerated than black widow antivenin
  - Whole IgE molecule

Disposition

- Systemic toxicity
  - Admit and monitor for 24 hours
  - Cardiopulmonary monitoring
- If severe consider PICU admission
- Can discharge if:
  - No systemic toxicity
  - Good pain control
  - Over 1 year of age
Prevention

- Prefer cool, damp areas, under rocks and logs
- Clear away debris, trash, logs and bricks
- Mow grass and keep it short
- Fix holes and cracks in the house
- Hide in shoes, clothes and bedding