Snake Bites in WY

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Objectives

■ Discuss:
  ▪ Taxonomy
  ▪ Epidemiology
  ▪ Crotalid/Elapid Envenomations

■ Review:
  ▪ Prairie rattlesnake
  ▪ Midget Faded rattlesnake
  ▪ Herpetoculture in WY

■ Become familiar with the recognition, evaluation, and management of crotalid snake bites
■ Review dosing and preparation of antivenin.
Poisonous or Not??

Head of nonvenomous snake

Head of venomous snake

Tail of nonvenomous snake

Tail of venomous snake

Round pupil

Nostril

Vertical pupil

Pit

Two scale rows

Cottonmouth Copperhead

Single scale row

Rattlesnake
Venomous Snakes

- Around 3000 species of snake
- Around 600 known to be venomous
  - ONLY TWO IN WY
  - 4 families:
    - Colubridae
    - Atractaspidae
    - ELAPIDAE
    - VIPERIDAE
Epidemiology of Snakebite

- Study group of 86 patients
- 87% male, 13% female
- 74% between 18-50 years old
- 56% alcohol associated
- 73% of upper extremity bites were illegitimate
- 56.6% of bites were illegitimate
- Tattoos not officially studied

Snake Bite Mortality by ME Data

Table 1. State death counts

- Alabama 4
- Arizona 7
- Arkansas 1
- California 6
- Colorado 2
- Florida 14
- Georgia 12
- Idaho 2
- Kansas 1
- Kentucky 4
- Louisiana 1
- Maryland 1
- Mississippi 2
- New Mexico 2
- New York 1
- North Carolina 2
- Ohio 1
- Oklahoma 2
- South Carolina 4
- South Dakota 1
- Tennessee 2
- Texas 17
- Virginia 3
- Washington 2
- West Virginia 2
- Wyoming 1
Table 2. Sex as percentage of total deaths from reptile envenomation
Raw death Percentage death Sex count count (%)

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>21</td>
<td>76</td>
<td>97</td>
</tr>
<tr>
<td>Count</td>
<td>22</td>
<td>78</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>White/F</th>
<th>White/M</th>
<th>Black/F</th>
<th>Black/M</th>
<th>Other/F</th>
<th>Other/M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>14%</td>
<td>77%</td>
<td>6%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Snake Bite Mortality by ME (3)

- Divided by age/gender
  - 20% deaths in males 25-34
  - 12% deaths male 35-44
  - 13% deaths male 45-54
  - 11% deaths male >65
Frequency of Snakebite
(U.S. Poison Centers, 2011)

- 3,584 snake bites nationwide (NPDS)
  - 1,218 rattlesnake
    - 68 fatalities
WY snake bite epidemiology

Data from Nebraska PCC/NPDS
- 2005-2013
  - 2 animal bites
  - 79 human bites
    - 76 admitted
    - 71 were rattlesnakes
      - 2 (+) ID prairie rattlesnake
      - 45 received AV
      - NO FATALITIES
Prairie Rattlesnake

- Usually 35-45 inches long
- Weigh approx 1 lb
- Gray – green with greenish blotches
  - Blend with prairie landscape
    - Bites usually not fatal
Midget Faded Rattlesnake

- One of smallest rattlesnakes in region
  - Commonly protected
    - Collect/transport w/o permit is felony violation
  - Looks like Hopi rattlesnake
  - Approx 28 inches in length
  - Cream to yellow brown
  - Blotches are darker and fade with age
  - Venon high in neuro/myotoxin
    - ? Most toxic of western clade
Crotalide/Pit Viper Characteristics

Crotaline head shape

![Diagram of a rattlesnake head showing elliptical pupil, nostril, and heat-sensing pit.](image)

Profiles of typical crotalid rattlesnakes showing scale formation and head configuration.

(Crotalid Rattlesnake)  (Pygmy Rattlesnake)  (Cottonmouth)  (Copperhead)  (Coral Snake)
Crotalide fangs/venom apparatus

- Fangs are 1-1.5 cm long
- Fangs turned over constantly
Strike Characteristics

- Strike from any position
- May or may not give warning
- Up to 1/3 of their body length
Bite characteristics

- Venom usually injected SQ
  - Rarely IM
  - Rarely IV (rapid systemic sequelae)

- Puncture wounds, lacerations or abrasions may be evident

- May not get history of a bite or accurate ID of the snake
Crotalide Venom

- Mixture of proteins, peptides, amines
- The exact composition varies:
  - Species
  - Geographical location
  - Time of year/time of day
  - Last feeding
- None, some or all of the venom may be injected (20% end up being “dry” bites)
Venom characteristics

- RNA-ase and DNA-ase
- Kinins
- Leukotrines
- Histamine
- Phospholipase
- Serotonin
- Acetylcholinesterase
- Collagenase
- Metallic ions

- Unidentified:
  - Procoagulants
  - Anticoagulants
  - Cardiotoxins
  - Hemotoxins
  - Neurotoxins

- Significant cross-reactivity between species
Pathophysiology

- Increase permeability of capillaries → extravasation of blood, albumin and electrolytes; effects on RBC membranes can result in hemolysis
- Increase in inflammatory mediators
- Leukocyte migration
- Coagulopathy
Clinical Effects (Viperidae)

Three main types:
1. Local
2. Systemic
3. Hematologic

Symptoms can be delayed (hours)!
Local Effects

- Puncture wounds (1-4) may be present
Local Effects

progress over time
Local Effects (severe)

Blistering and compartment syndrome (rare) may occur.
Compartment Syndrome

- If muscle injury does occur, it is most likely due to myotoxins and not elevated compartment pressures.
- Antivenin decreases compartment pressures.
- Compartment pressure > 30-50 mm Hg:
  - Confirmed subfascial
    - consider fasciotomy
- Routine fasciotomy **not** recommended!!!
Systemic Effects

- Hypotension, tachycardia
- Nausea/vomiting
- Diaphoresis
- Light-headedness
- Metallic taste
- Painful adenopathy
- Neurologic effects with some bites (eg. Mojave)
- Rhabdo
Effects - Hematologic

- Thrombocytopenia
- Coagulopathy (elevated PT/PTT)
- Low fibrinogen (increased FSP)
- Bleeding
- Recurrence common
# Severity of Envenomation

<table>
<thead>
<tr>
<th></th>
<th>Minimal</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local Effects</strong></td>
<td>Limited to bite site</td>
<td>Limited to affected extremity</td>
<td>Extend beyond affected extremity</td>
</tr>
<tr>
<td><strong>Systemic Effects</strong></td>
<td>None</td>
<td>None or Mild: nausea, emesis, oral paresthesias, altered taste</td>
<td>Marked: altered mentation, tachycardia, hypotension, respiratory distress</td>
</tr>
<tr>
<td><strong>Coagulation Parameters</strong></td>
<td>Normal</td>
<td>May be abnormal, but no bleeding</td>
<td>Abnormal, with serious or potentially serious bleeding</td>
</tr>
</tbody>
</table>

None or Mild:
- Nausea
- Vomiting
- Oral paresthesias
- Altered taste

Marked:
- Altered mentation
- Tachycardia
- Hypotension
- Respiratory distress
Typical Elapid Body

- More slender
- Head less triangular, less distinct
- Larger, fewer scales
- Smaller fangs
Clinical Effects (elapidae)

- Neurotoxic flaccid paralysis (3-12 hrs)
  - Typical progression:
    - Ptosis → ophthalmoplegia → dysarthria → poor tongue protrusion → dysphagia → drooling → limb weakness → diminished DTRs → respiratory paralysis
- Rhabdo possible
- Can see local effects (cobras), coagulopathy rare
- Corneal irritation, blurry vision
Treatment - Field/Pre-hospital

- Many purported field treatments:
  - Incision and suction
  - Tourniquets
  - Electric shocks
  - Ice
  - Alcohol
  - Poultices and folk remedies

- None have any proven benefit
- Potentially harmful
Field/Pre-hospital (2)

- What to do in the field?
  - Stay calm!
  - Consider lymphatic band
  - Immobilize extremity
  - Avoid activity
  - BLS principles
  - *Rapid* transport

- Most patients will survive if they get to medical care
Treatment - In-Hospital

- All bites treated alike
- ABCs
- Monitor local effects
  - Hash marks q 15-30 minutes
- Monitor vital signs
- Elevate limb
- Analgesia
- Monitor for coagulopathy
  - PT/INR, platelets, fibrinogen q 6-8 hrs or after antivenom dose
- ICU vs floor admission
- Tetanus
- No prophylactic antibiotics
  - (except elapids)
- “Dry Bite” or no progression – DC home after obsv.
Serial Measurements

Virginia Poison Center
Crotaline Envenomation Flowsheet

Patient Name ________________________ Age _______ MR # ________________________

Date and Time of Bite: 5/2 1830 Previous A/V: Y Type: _____________

Bite Location: ☐ ANKLE - MEDIAL MALLEOLUS

<table>
<thead>
<tr>
<th>Location</th>
<th>FOOT</th>
<th>ANKLE</th>
<th>CALF</th>
<th>KNEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaffected limb (control)</td>
<td>25cm</td>
<td>23.8</td>
<td>37.5</td>
<td>38.5</td>
</tr>
<tr>
<td>Envenomated limb</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time measured</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900</td>
<td>26.5</td>
<td>25.0</td>
<td>37.5</td>
<td>38.5</td>
</tr>
<tr>
<td>1915</td>
<td>27.0</td>
<td>26.0</td>
<td>37.5</td>
<td>38.5</td>
</tr>
<tr>
<td>1930</td>
<td>27.2</td>
<td>28.3</td>
<td>38.0</td>
<td>38.5</td>
</tr>
</tbody>
</table>
AV Treatment

Crotalidae Polyvalent Immune Fab (Ovine)
CroFab™

Package contains two vials of CroFab™ for intravenous injection. Diluent not included.
To be reconstituted with 10 mL Sterile Water for Injection USP by continuous mixing.
Use immediately after reconstitution. Store at 2-8°C (36-46°F). Do not freeze.

For intravenous injection. To be used immediately after reconstitution.

Malayan Krait Antivenin
Bungarus candidus

Manufactured by Queen Saovabha Memorial Institute
The Red Cross Society
Bangkok 10600, Thailand

For intravenous injection. To be used immediately after reconstitution.
US Crotaline Antivenom

**Wyeth: Historical Treatment**
- Older (1954)
- Equine
- Mixed monovalent IgG
- Less pure
- Greater incidence of serious allergic reactions, serum sickness
- Skin test recommended
- Takes longer to go into solution
- No longer produced

**CroFab: DOC**
- Newer (2000)
- Ovine
- Mixed monovalent Fab
- Affinity purified
- Lower incidence of serious allergic reactions
- No skin test
- Goes into solution quicker
- More frequent dosing
- $$$$$
Antivenom

- Made from animals immunized against various pit viper venoms
- Immunoglobulins or Fab fragments
- Bind to venom components and inactivate them
Crotalide Ovine Fab Antivenin

- Prospective multicenter clinical trial (1993)
- N = 11 patients (age > 10)
- Mild-moderate crotalid bite within 6 hours
- Exclusions:
  - *Copperhead* bites
  - Severe envenomations
- Results – all patients improved after Fab
  - Subsequent progression in 3 patients
  - No acute reactions
  - No serum sickness (1 mild delayed allergic rxn)

## IMMUNIZING VENOMS

<table>
<thead>
<tr>
<th>Conventional Antivenom</th>
<th>Western Diamondback Rattlesnake <em>Crotalus atrox</em></th>
<th>Eastern Diamondback Rattlesnake <em>Crotalus adamanteus</em></th>
<th>Mojave Rattlesnake <em>Crotalus scutulatus</em></th>
<th>Cottonmouth <em>Agkistrodon piscivorus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Diamondback Rattlesnake <em>Crotalus atrox</em></td>
<td>Eastern Diamondback Rattlesnake <em>Crotalus adamanteus</em></td>
<td>South American Rattlesnake <em>Crotalus durissus terrificus</em></td>
<td>Fer-de-Lance (South America &amp; Costa Rica) <em>Bothrops atrox</em></td>
<td></td>
</tr>
</tbody>
</table>
Antivenom Indications

- **Hard**
  - Progressing local symptoms
  - Coagulopathy
  - Thrombocytopenia
  - Systemic signs and symptoms
  - Neurologic symptoms or known elapid bite

- **Soft**
  - One cell line out
  - Recurrence
  - Nausea, vomiting
Crofab Dosing

- 4-6 vials
  - (+) initial control → go to maintenance
  - (-) initial control → repeat dose

- Maintenance
  - 2 vials q6 hr x 3
  - (often not needed, esp with copperhead)

- Recurrence
  - 2 vials
Document indications for antivenin therapy

Establish initial control with 4-6 vials administered over one hour

Initial control achieved?

Yes

Infuse 2 vial doses at 6, 12 & 18 hrs after initial control achieved

NO - repeat 4-6 vials
## Adverse Reactions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Crotalidae Polyvalent</th>
<th>Cro-Fab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin test</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Anaphylaxis</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Acute reactions</td>
<td>23-56%</td>
<td>14%</td>
</tr>
<tr>
<td>Serum sickness</td>
<td>15-86%</td>
<td>16%*</td>
</tr>
</tbody>
</table>
Crofab and Severe Bites

- No standard definition
- Chart review from 17 hospitals
- 265 patients treated with AV (94% Fab)
- 28 (12%) classified as severe
- 53.6% due to rattlesnakes; 46.4% unknown snake
- Median loading dose: 12 vials in 2 doses
- 57% achieved initial control after LD
- Severity score: $5.3 + 0.4 \rightarrow 1.3 + 0.9$ after LD
- 8/11 (73%) patients evaluated had recurrence of symptoms
- No fasciotomies; no fatalities

Dart et al, unpublished.
Treatments to Avoid

- Cryotherapy
- Cut and suck
- Tourniquet
- Electric shock
- Fasciotomy
  - Except in rare circumstances
Remember Beware of surgeons (no offense)
WY Herpetoculture

https://www.facebook.com/pages/Breeders-against-United-States-Herpetoculture-Alliance-Inc/119327808236493
Who am I?

- I live in the southwest US. I have a venom that causes severe soft tissue damage and coagulopathy.
Name this snake!

- I am the largest venomous snake in N. America. I have a bad disposition, cause a severe coagulopathy and tissue necrosis, and love that Florida sun.
Do you know my name?

I love the desert southwest. I am a pit viper with neurotoxic venom.
I enjoy the hot/humid and swampy south. I love to swim.
What about me?

- I like the mid-Atlantic region and the south. Some say my bites are whimpy and only cause local soft tissue effects. But what I lack in toxicity I make up for in quantity. I am responsible for more bites in the US than any other snake.
Exotic or Non-Indigenous Snakebites Managed by Virginia Poison Center

- Black Pakistani cobra (2001)
- Canebrake rattlesnake (2002)
- Western diamondback (2003)
- Eastern diamondback (2005)
- Arizona black rattlesnake (2006)
- Indian cobra (2007)
Acknowledgements

- Mark Kostic, MD
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