“Look Doc, I Even Brought the Snake!”

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Disclosures

- None
Snakebites
Snakes

“…thou art cursed above all cattle and above every beast in the field; upon thy belly thou shalt go, and dust shalt thou eat all the days of thy life” Gen. 3:14
Snakes

• There are approximately 400 species of venomous snakes in the world and roughly $\frac{1}{2}$ of these are dangerous to man.

• The main families include:
  – Atractaspididae (front, mobile fangs)
  – Colubridae (rear fixed fangs)
  – Hydrophiide (sea snakes, front fixed fangs)
  – Elapidae (front fixed fangs)
  – Viperidae (front mobile fangs)
Viperidae

- Divided into subfamilies
  - Viperinae
    - Old World Vipers
  - Crotalidae
    - Pit vipers or New World Vipers
Venomous or not?

- Generally, in the US poisonous snakes will have triangular heads and elliptical pupil and a pit between the nostril and eye.
- Poisonous snakes have a single row of caudal plates.
Venomous or not?
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Venomous or not?
Crotalids

• 3 Genera in the USA
  – *Crotalus*
  – *Sistrus*
    • Both are referred to as rattlesnakes
  – *Agkistrodon*
    • Includes copperheads and cottonmouths
US Snakebite Epidemiology

- Male to female ratio = 9:1
- Average age 24
- 60% Handling snake
- 28% intoxicated
- 85% on finger or hand

Crotalid Envenomation

- Venom is a mixture of enzymes, metals, and other proteins.
- Deposited into subcutaneous tissue and spread through lymphatics.
Venom Purpose

• Aid digestion
  – hyaluronidase breaks down connective tissue
  – phospholipase A2 causes cell membrane damage,
  – proteolytic enzymes cause myonecrosis
  – thrombin-like enzymes cause a coagulopathy.
Venom Purpose

• Kill prey.
  – Lethal proteins damage endothelial cells resulting in increased vascular permeability.

• Clinically, these proteins can cause shock and ALI
Grades of Envenomation

• None:
  – ~25% dry bites. Fang marks, no local or systemic effects.

• Mild:
  – Local erythema and swelling

• Moderate:
  – Increasing swelling, systemic findings

• Severe:
  – Rapid progression, coagulopathy, hypotension, acute lung injury
Crotalid Envenomation

- Most serious envenomations from rattlesnakes
- Mojave rattlesnake has been reported to render blood incoagulable
- Tissue damage most common complication
  - edema, hemorrhagic blebs and lymphangitis
- Significant crotalid envenomation
  - coagulopathy, thrombocytopenia and hemorrhagic shock
Tissue Injury

- Venom metalloproteinases activate TNF-α
  - may result in myonecrosis
- Myotoxin-a causes influx of Ca\(^{2+}\) into the sarcoplasmic reticulum of muscle cells.
  - Overload of calcium ions eventually results in muscle necrosis
Coagulopathy

- Species specific components of venom deplete fibrinogen and elevate FDPs
- DIC uncommon
  - May result from intravascular envenomation
- Thrombocytopenia not well understood
  - May result from phospholipase mediated platelet dysfunction
Neurotoxicity

- Very unusual in crotalid bites
- Mojave Rattlesnake
  - Respiratory depression
- Timber Rattlesnake may produce myokymia
  - Appears like a bag of worms moving under the skin.
  - Associated with pre-synaptic calcium channel blockade
  - Improves with IV administration of calcium salts
Agkistrodon spp

- Copperheads and Water Moccasins rarely cause life threatening injury
- May cause severe local swelling and discomfort
- Pts often only require analgesia and observation
Prehospital Treatment

• Old wives tales:
  – Incise and suck
  – Tourniquets (although compression bandaging may help)
  – Whiskey
  – Toad pee
Prehospital Treatment

– Criss cross cuts around bite site
– Electric shock therapy
– Fresh chicken entrails
– Kill the snake so as to apply the fleshy part of the tail to the wound
– Sage and black cohosh
Prehospital Treatment

- Extractor suction devices may remove some toxin if applied within minutes of injury.
Prehospital Treatment

• GENTLE application of compression bands may limit lymphatic spread
Prehospital Treatment

- The most important piece of equipment
  - Your car key
- Get medical attention
Hospital Treatment

- ABCs
- Examine for signs of envenomation
- Tetanus status
- Antibiotics are controversial
- Mild elevation of extremity
- Analgesia
- X-ray for FB
Hospital Treatment

• Fluid replacement as necessary
• Usually no need for blood products as antivenin usually reverse coagulopathy
• Clinical monitoring is often sufficient
Antidote

• In case of significant envenomation consider CroFab.
Antidote

- Purified ovine derived Fab fragments
  - Neutralize effects of crotalid bites
- Indications
  - Rapidly progressive tissue injury
  - Swelling extends beyond three joints
  - Coagulopathy
Antidote

• Start with 4-6 vials
• If signs of envenomation are not improving then repeat first dose then maintenance dose should be started with 2 vials q 6 x 3
• Initial dose should be given slowly over the 1st 10 minutes to observe for allergic reaction
Antidote

• Older Wyeth Crotalidae antivenin derived from horse serum.
• Partially purified whole immunoglobulin
  – Often caused anaphylaxis
  – Serum sickness
  – People with horse allergies needed to be pretreated
Antidote

- CroFab is very expensive
- Recurrence of coagulopathy has occurred with CroFab
  - probably due to short $t_{\frac{1}{2}}$
- Fewer allergic complications
- Use judiciously - supplies often run short
Elapids

• Snakes are highly venomous
• Include Cobras, kraits, taipans, mambas
• Envenomation results in neurotoxicity and often is rapidly fatal without treatment
Toxins

• Alpha-bungarotoxin acts on the postsynaptic site.
  – binds to nicotinic acetylcholine receptor on the postsynaptic membrane
  – Prevents depolarization

• Beta-bungarotoxin acts on presynaptic site.
  – Prevents release of acetylcholine
Elapids

- The cobra is probably the most well known (and feared) elapid.
- Found in Asia, Africa and Australia.
- Subject of many myths and stories
- Revered in Hindu religion
Elapids

- This famous woman committed suicide by clasping an asp to her breast. Who was she?
Elapids

• Only elapid in USA is the coral snake
• Small snake with small teeth but can chew on toes and fingers
• Potent neurotoxic venom
Coral Snake

- Minimal local effects
- Significant envenomations lead to diplopia, dysphagia, fasciculations, paralysis and respiratory failure
- Prolonged ventilation may be required
Coral Snake

- Treatment with Wyeth *M. fulvius fluvius* antivenin
- Given delayed presentation, usually give 5 vials even before symptoms begin
- Work on a drug like CroFab in progress
Take home points…

• When treating exotic snakebites horse derived antivenin is used
• Snake-handlers know which species of snake bit them
• Often do not want treatment
Take Home Points….

- Always have epinephrine drip at bedside
- Expect anaphylaxis
Medicinal Uses of Snake venom

- Venom is used for many purposes
- Ancrod derived from Malaysian pit viper is being tested as an alternative for tPA in ischemic stroke
- Captopril was derived from venom of the jararaca pit viper
Case 1

• Mr. EB, 49 y.o. man out on camping trip with friends.
• Left tent at 11:30 pm, reached down to pick up a bucket and felt a sharp pain on his right index finger.
• Looked down and saw this snake slithering away.
Case 1

• Pts hand had initially looked like this:
Case 1

• When he got to our ED (several hours later) he was complaining of chills and arm pain and his arm looked like this:
Case 1

- Denied tingling and numbness in hand
- Left hand dominant
- No nausea or vomiting
- PMHx: Nil
- PSHx: Tonsillectomy
- Meds: Nil
- All: Phenergan/Codeine
Case 1

• FHx: DM
• SocHx: Assembly line worker +ETOH
• Last tetanus < 2 years ago
Case 1

- Gen: Alert and conversational in moderate discomfort
- VS: 140/86, HR 67, RR 20, T 36.6, SaO2 95% on RA
- HEENT – OP clear, PERRLA
- CVS – RRR s MRG
- PULM - CTA
Case 1

- **ABDO** – Soft NT/ND, no HSM
- **EXT** –
  - R arm erythematous and swollen past elbow.
  - 2 cm irreg blister on index finger distal radial side.
  - MUR motor and sensation intact
- **NEURO** – A&Ox3, CN II-XII intact, MAEW, sensation intact
Case 1

WHAT DO YOU WANT TO DO?
Case 1

- WBC-16, H&H 15/44, PLT-253
- PT-12.6/PTT 24.3
- FDP - < 2 mcg/ml (n=<3 mg/mL)
- Fibrinogen – 258 mg/dl (n=160-350 mg/dL)
- Na 143, K 3.7, Cl 107, HCO3 25, BUN 10, Cr 0.9, Glu 122
Case 1

NOW WHAT DO YOU WANT TO DO?
Case 1

- Toxicology consult
- Elevate arm, serially mark extent of swelling
- Analgesia
- CroFab – 5 vials loading dose followed by maintenance dose of 2 vials q 6 hours x 3
Case 2

- 5 y.o. boy walking on driveway barefoot felt sudden stinging sensation in L heel.
- Ran into house crying. Mom noted fang marks and swelling on heel.
- Mother had seen copperheads as well as this kind of snake in the yard
Case 2

- PMHx: Nil
- PSHx: Nil
- All: Nil
- Meds: Nil
- Imm: UTD
Case 2

• Gen – Pt sleeping quietly on bed
• VS – AFVSS
• CVS – RRR s MRG
• PULM – CTA
• ABDO – Soft NT/ND
• EXT - Small amount of bruising over heel + puncture wound approximately 6 hrs post bite
Case 2

WHAT DO YOU WANT TO DO?
Case 2

- WCC 21/H&H 14&40/ PLT 120
- PT – 12.1/INR 0.91/PTT – 24
- Fibrinogen – 200 mg/dl
- FDP < 2 mcg/ml
Case 2

WHAT DO YOU WANT TO DO NOW?
Case 2

- Toxicology Consult
- Tetanus - UTD
- Watch ankle for serial circumference measurements and ecchymosis.
- Analgesia
- No need for CroFab
Case 3

• 18 y.o. woman reached down to pick up a hose, saw this baby snake and picked it up to get it out of the way....
Case 3

- Felt sharp pain in her thumb.
- Initially, thumb looked like this…
Case 3

- Over next 15 minutes, pain progressed to forearm.
- Over several hours, arm began to appear like this…
Case 3

WHAT DO YOU WANT TO DO NOW?
Case 3

• Labs all normal.
Case 3

• Toxicology consult
• Elevate arm, serially mark extent of swelling
• Analgesia
• CroFab – 5 vials loading dose followed by maintenance dose of 2 vials q 6 hours x 3
Take Home Points

• May have delayed or recurrent coagulopathy and thrombocytopenia with rattlesnake envenomation.
• Copperheads do not cause coagulopathy.
• Compartment syndrome vanishingly rare in North American viper bites.
Questions?


