

Snakebites

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Snakebites

Epidemiology

- f About 3000 species of snakes worldwide
- f 375 medically important venomous snakes worldwide
- f Snakes belong to Class Reptilia, Order Squamata, Suborder Serpientes
 - Comprised of 11 families
 - Venomous snakes are in 5 families

Venomous Snakebite Epidemiology

f 5 families of venomous snakes & representative species :

–Colubridae

f Boomsnake, Bird snake

–Elapidae

f Coral snakes, cobras, kraits, mambas, most Australian snakes

–Hydrophiidae

f Sea snakes, sea krait

–Viperidae

f Vipers, adders, asps (Old World)

–Crotalidae (pit vipers)

f Rattlesnakes, Fer-de-lance, Bushmaster, copperhead

General Anatomic Comparisons of Venomous Snakes

- f Colubridae : rear - fanged
- f Elapids : front fangs, fixed maxilla
- f Vipers : (both true & pit vipers) front - fanged, mobile maxilla

Snakebites

Envenomation Risk

- f Factors determining relative risks of human envenomation by different snakes :
 - Venom toxicity / potency
 - In some species : size of the snake
 - "Effectiveness" of the bite (at injecting venom)
 - Innate aggressiveness of the snake
 - Likelihood of human contact

Risk of Snakebite in Field Situations

- f Southern Arizona Rescue Association : 115,000 man hours in "snake country" with no bites
- f LeSelva Biological Station in Costa Rica 1968 to 1987 : 350,000 man hours without incident
- f Organization for Tropical Studies in Costa Rica : one Fer-de-lance bite in 660,000 man hours

Basic Purposes of Snake Venom

- f Immobilize prey
- f Assist in or start the digestive process
- f Deter other predators

Functional Classification of Composition of Snake Venoms

f Neurotoxins

- Mainly paralytic agents
- These are main toxins from cobras, sea snakes

f Myotoxins

- Cause tissue necrosis

f Hemotoxins

- Cause coagulopathies
- These are main toxins from pit vipers

f Locally active toxins

- Cause tissue necrosis, blistering

Components of Snake Venom

- f Almost all are complex, multi-component mixtures :
 - Proteolytic enzymes
 - Collagenases
 - Hyaluronidase
 - Phospholipase
 - Lactate dehydrogenase
 - Acetylcholinesterase
 - Nucleotidases
 - Steroids
 - Inorganic elements : zinc, magnesium
 - Histamine, bradykinins, serotonin
 - Aminopolysaccharides

Venomous Snakes

- f Crotalidae (pit vipers) : 95 % of bites :
 - Rattlesnakes : about 20 species in 47 states
 - f Mojave rattlesnake : only one with mainly neurotoxins ; only in Arizona
 - Cottonmouth (Water Moccasin) : Midwest and South states
 - Copperhead : in about 40 states ; least toxic (almost never requires use of antivenin)

Identification Characteristics of Venomous Snakes

f Pit Vipers

- Indentation or "pit" between eye and nostril
- Flat triangular-shaped head
- Vertical pupils
- Curved fangs (usually 2 ; sometimes 1 to 4)
- Rattlesnakes have "rattle" at end of tail

f Coral Snakes

- Rounded head, black snout
- Red & black bands separated by yellow or white rings
- "Red on black: venom lack ; red on yellow: kill a fellow" is how to tell apart from banded King and corn snakes

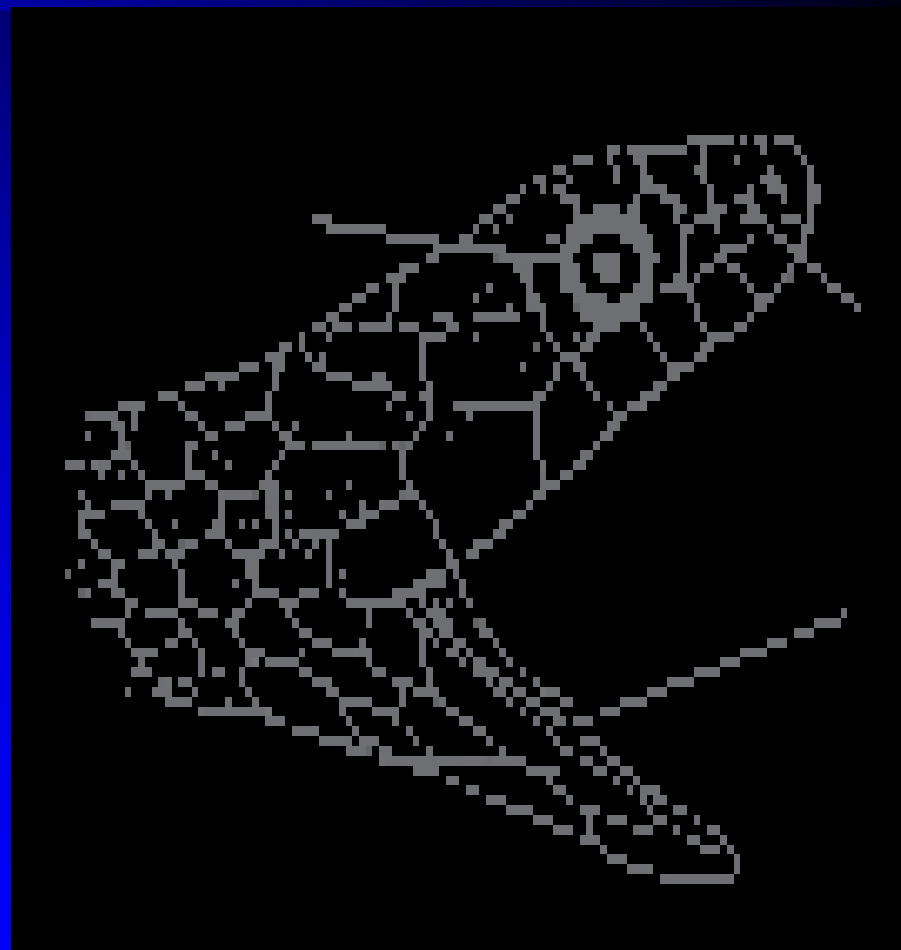
Identification Characteristics of Non-venomous Snakes

- f rounded head
- f round pupil
- f 2 rows of small teeth
- f Double row of subcaudal plates (less reliable)

Note: many non-North American venomous snakes have above characteristics

می توان مارهای سمی را با در نظر گرفتن مشخصات زیر از مارهای غیرسمی تشخیص داد:

1. سر مثلثی شکل در مارهای سمی، در مقایسه با سر باریک و مدور در مارهای غیرسمی؛
2. حفره 1 بین چشم‌ها در صورت و حفره 2 بین 2 در افع‌یهای حفر هدار و نبود این حفرها در سایر گونه‌ها) این حفره به عنوان یک حس گر حرارتی و ارتعاشی برای مار عم‌لمی کند)؛
3. مردم‌کهای بیض‌ی‌شکل عمودی 3) مانند گربه (در مارهای سمی، در مقایسه با مردم‌کهای مدور 4 در مارهای غیرسمی) مارهای سمی از تیره مرجان 5 با توجه به داشتن مردمک‌های مدور استثنا هستند)؛
4. یک ردیف فلس در انتهای دم مارهای سمی، در مقایسه با دو یا چند ردیف فلس در انتهای دم مارهای غیرسمی؛
5. دندانهای اختصاصی‌افته تزریق‌زهر 6 در مارهای سمی، و نبود این نوع دندان‌ها در انواع مارهای غیرسمی.





- 1، کفچه مار
- 2، مار جعفری
- 3، گرز همار
- 4، مار شاخ دار
- 5، افعی زنجانی
6. افعی قفقازی



پراکندگی جغرافیایی:
استان های مرکزی، تهران،
گیلان، مازندران و گلستان.

Characteristics of Pit Vipers

- f Deaf, poor vision, color blind
- f Excellent sense of smell and vibration
- f Feed at night ; less active during day
- f Are venomous from birth
- f Are strict carnivores
- f Top speed only 3 m.p.h.
- f Can strike at > 8 feet/second speed
- f Strike up to half body length
- f Live up to 30 years

مارهای غیرسمی



پراکندگی جغرافیایی:
مناطق مختلف کشور.

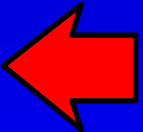
Venom Apparatus of Pit Vipers

- f Venom gland is modified salivary gland
- f Venom duct runs into groove in fangs
- f Fangs retract or fold down when snake closes mouth
- f Anywhere from 20 % to 75 % of venom in gland can be discharged at one strike
- f Snake has some control over amount of venom injected : tends to inject larger amounts if suspected larger prey
- f Small snakes have lesser amounts of venom than larger snakes
- f If fang breaks, it can be replaced by a new one growing in from behind

Major Actions of Pit Viper Venom

- f Local tissue damage / necrosis
- f Coagulopathy
 - Thrombocytopenia
 - Fibrinolysis
- f Hemolysis
- f Vascular wall / capillary damage
- f Neurotoxins : from Mojave rattlesnake cause respiratory paralysis

Complications of Pit Viper Envenomation

- f Hypotension : can progress to frank shock
- f Pulmonary edema or respiratory distress syndrome
- f Disseminated intravascular coagulation / fibrinolysis
 - Bleeding from bite site, mucus membranes, other sites
 - Thrombosis of smaller vessels
- f Rhabdomyolysis*
- f Fasciculations*  *these can cause acute renal failure
- f Hemolytic anemia*

Manifestations of Coagulopathy in the Envenomated Patient

- f Bleeding from bite site
- f Hematuria
- f Epistaxis
- f Melena
- f Petechiae / Purpura

Sequence of Local and Regional Signs and Symptoms from Pit Viper Envenomation

(in rough order of occurrence)

- f Pain
- f Swelling / edema
- f Ecchymosis
- f Fasciculations
- f Vesiculation
- f Tissue necrosis

Systemic Envenomation Symptoms from Pit Viper Bites

- f Perioral tingling or numbness
- f Numbness of extremities or scalp
- f Metallic taste in mouth
- f Nausea and vomiting
- f Weakness
- f Diaphoresis
- f Faintness / Chills
- f Coagulopathy
- f Neurologic (rare) : paralysis, seizures

Symptoms & Signs of Envenomation by Copperheads

- f Pain disproportionate to appearance
- f Proximal pain
- f Extremity paresthesias
- f Bitter or altered taste
- f Nausea
- f Lightheadedness
- f Edema & ecchymosis at site with proximal progression
- f Normal platelets, protime
- f Mild rhabdomyolysis

Symptoms & Signs of Envenomation by Rattlesnakes

f Similar to copperhead, except :

- Vomiting & other systemic sx & signs
- Rapid onset severe thrombocytopenia
- Site bleeding
- Delayed hemorrhagic bullae
- Generalized fatigue
- Tissue necrosis
- Metallic taste
- D.I.C.
- Severe rhabdomyolysis

Systemic Envenomation Symptoms from Elapidae (Coral Snake) Bites

- f Mild pain +/- paresthesias at bite site
- f Peripheral nerve block (numbness +/- motor weakness)
- f Ptosis / blurred vision
- f Muscle weakness
- f Hypersalivation / nausea / dyspnea
- f May progress to diaphragm paralysis & respiratory failure
- f Cobras cause above effects & also cardiotoxic effects

Diagnostic Confirmation of Venomous Snakebite

- f History of confirmed strike : if only suspected, could be just injury from thorns or branch, etc.
- f Fang puncture marks
 - may be one to four in number per strike (if snake strikes more than once, can be multiple)
 - If skin marks are in multiple rows, this implies non-venomous snake
- f Local +/- systemic envenomation signs

First Aid and Field Therapy for Snakebites

- f Avoid panic & retreat out of snake's striking range
- f Immobilize the affected part & limit activity
- f Place lymphatic constriction band
- f Don't try to capture & carry the snake
- f Rapid transport to medical facility
 - Try to make sure the medical facility has sufficient antivenin (20 to 30 vials may be required)
 - Cleanse & irrigate the bite site if this will not delay transport

تلاش برای به تأخیر انداختن جذب سیستمیک سم مار؛
حفظ حیات بیمار و پیشگیری از بروز عوارض پیش از رسیدن بیمار
به بیمارستان یا سایر مراکز درمانی؛
کنترل دیسترس یا علائم زودرس و خطرناک ناشی از مارگزیدگی؛
فراه نمودن شرایط انتقال بیمار به بیمارستان یا سایر مراکز درمانی؛
پرهیز از اقدام‌هایی که به آسی بدیدن بیشتر بیمار منجر می شود.

اقدام های خطرناک

شوک

الکتریکی؛

ایجاد برش، خراش یا سوراخ در
محل گزیدگی؛

تلاش در جهت ساکشن سم از محل
گزیدگی؛

سفت بستن تورنیکه به دور اندام
مارگزیده؛ کمپرس سرد

اقدام های درمانی اولیه:

آرا نمودن آسی بدیده مضطرب و
اطمینان دادن به او که مرگ ناشی
از مارگزیدگی بسیار نادر و خیلی
کمتر از زنبورگزیدگی است؛
دور نمودن آسیب دیده از محل
حادثه) ب همنظور جلوگیری از
گزیدگی مجدد)؛

قرار دادن بیمار در وضعیت نشسته یا
درازکش؛ در حالی که اندام
مارگزیده در موقعیت افقی قرار گیرد؛
ب یحرک تنمودن اندام مارگزیده ب
هوسیلۀ آتل یا باند پارچ های) هر
گونه

حرکت یا انقباض عضلانی ممك
ناست به افزایش ورود سم مار به
جریان خون و لنف منج رشود)؛
خارج ساختن تمام وسایل زینتی مانند
ساعت و انگشتر؛

پرهیز از هرگونه دستکاری زخم
ناشی از گزیدگی(ممکن است به
عفونت، افزایش جذب سم و خو
نریزی موضعی منجر شود)؛
شستشوی محل گزش با آب و صابون
و بانداژ اندام مارگزیده؛
استفاده از برانکار، در صورت نیاز
به حمل مارگزیده.

Sequence of Standard Therapy for Pit Viper Snakebite

f Oxygen

f Place IV line and draw blood for :

- blood type / crossmatch, CBC, platelet count, protime, PTT, fibrinogen, electrolytes, BUN, creatinine, glucose, CPK, liver function tests
- Lymphatic tourniquet / splint
- Urinalysis / EKG
- Tetanus toxoid immunization
- Wound cleansing / irrigation ; consider antibiotics
- Consider compartment pressure monitoring
- Consider use of antivenin ; base use and dose on classification of degree of envenomation

Classification of Degree of Envenomation by Pit Vipers

- f None (struck but no venom injected)
 - Puncture marks only
- f Minimal
 - Mild bite site pain & local swelling only
 - No progression by 60 minutes
- f Moderate
 - Swelling progresses beyond the bite site
 - Ecchymosis, skin blebs, paresthesias
- f Severe
 - Swelling or pain involves entire extremity
 - Any systemic sign (metallic taste, coagulopathy, etc.)
 - Any major lab value changes

Wyeth Antivenin Dosage for Pit Viper Bites

Degree of Envenomation	Dose (Number of vials)
None	None
Minimal	Zero to 5
Moderate	6 to 15
Severe	15 to 30

Antivenin for Pit Viper Bites

- f Marketed as Crotalidae Polyvalent Antivenin by Wyeth
- f Covers venom from U.S. rattlesnakes, cottonmouth, & copperhead
- f Made from refined horse serum from horses immunized with venom from Western & Eastern Diamondback rattlesnakes, South American rattlesnake, & Fer-de-lance
- f Separate antivenin required for Mojave Rattlesnake bites
- f Separate antivenin also required for coral snake or sea snake bites
- f Polyvalent Crotalidae antivenin also manufactured in Brazil

New Commercially Available Type of Antivenin

- f Crotalidae polyvalent immune Fab (CroFab, FabAV) became commercially available in the U.S. in December 2000
- f Derived from sheep hyperimmunized against *Crotalus atrox*, *C. adamanteus*, *C. scutulatus*, & *Agkistrodon piscivorus*
- f The sheep antibodies are treated with papain to cleave off the Fc fragments, leaving the Fab antibodies

Initial Clinical Experience with the New Fab Antivenin FabAV

- f More expensive than the Wyeth antivenin
- f Lesser incidence & severity of allergic reactions
- f Venom induced coagulopathy may be relatively more resistant to Fab than to Wyeth antivenin
- f Recurrence or delayed coagulopathy may occur
- f If coagulopathy is only a single factor deficiency and asymptomatic, then extra Fab doses may not be needed

Antivenin for Coral Snake Bites

- f Usually need 3 to 5 vials in 300 to 500 cc normal saline
- f Should give before development of symptoms because it may not be effective once symptoms develop

Skin Test for Sensitivity to Antivenin for Snakebites

- f Skin test for sensitivity to horse serum (0.02 ml. of horse serum diluted 1:10)
unnecessary & potentially hazardous**
 - Not 100 % predictive of anaphylaxis (both false negative & false positive)**
 - May sensitize patient to subsequent dose of antivenin**
 - Delays administration of antivenin**

Administration of Antivenin for Snakebites

f Pretreatment

- IV steroids (100 mg hydrocortisone or methylprednisolone)
- IV diphenhydramine 50 mg
- IV fluid loading : at least 300 to 500 cc LR or NS

f Reconstitute each antivenin vial with 10 cc sterile water

f Then dilute each vial dose in 100 to 250 cc D5W or NS

f Give each diluted antivenin vial dose over 1/2 to 2 hours IV (DO NOT IV push the vials) ; for first 10 minutes, give at TKO rate

f Stop or slow infusion (& consider epinephrine 0.1 mg boluses or drip IV) if patient manifests any signs of anaphylaxis (hypotension, wheezing, edema, hives)

f Incidence of major allergic reactions low with pretreatment

Repeat or Additional Doses of Antivenin

- f Reevaluate extremity circumference, pain, protime, & platelet count every 2 to 4 hours until stable
- f Infuse an additional 1 to 5 vials prn for any progression of above signs

Adjunctive Therapy for Snake Envenomation

- f Opiate analgesics
- f Constant elevation of limb above heart once antivenin is started, or for > 4 to 6 hours post-bite (use stockinette or hanging traction apparatus)
- f Splint affected joints
- f Hydration to lessen effect of rhabdomyolysis
- f Initiate physical therapy once pain & edema decrease

Disposition of Patients with Snakebites

- f Confirmed pit viper bite
 - Discharge if no evident envenomation after 4 hours
 - Admit to hospital if local signs or antivenin required
- f Suspected coral snake, Mojave rattlesnake, or exotic snakebite :
 - All should be admitted (usually to ICU)
 - May have delayed symptoms & signs
- f Monitor for progression of local or systemic signs and symptoms

Serum Sickness After Antivenin Administration

- f 75 % of patients receiving > 5 vials of antivenin develop serum sickness**
- f Manifested by fever, malaise, rash, arthralgias, lymphadenopathy**
- f Usually symptoms develop at 7 to 21 day delay**
- f Treat with systemic steroids (prednisone 1 to 2 mg/kg/day) for 7 to 10 days +/- antihistamines**

Contraindicated Potentially Harmful Treatments for Snakebites

- f Tourniquets beyond only lymphatic compression
 - Australians however utilize entire limb compression (via air splint or elastic wrap) to retard venom absorption
- f Cryotherapy (ice packs) : increases tissue damage
- f Electric shock
- f Excision of the bite site
- f Routine fasciotomy
 - Only rarely indicated if venom injected below muscle fascia (most injections are only subcutaneous)
- f Incision & suction of bite site
 - Only small amount of venom removable
 - Increases risk of infection and tendon damage

Snakebite Infections

- f Old references quote high infection rates from snakebites & recommend routine prophylactic antibiotics
- f Snake venom itself is sterile but snake mouth & exterior of fangs harbor fecal bacteria from the snake's prey
- f Two recent studies (one for venomous & one for non-venomous snakes) show low rates of infection & no need for prophylactic antibiotics

Precautions to Avoid Snakebite

- f Wear knee - high heavy boots & heavy gloves
- f Watch where you are walking, sitting, or grasping
- f Don't put your hands into ground holes, or under rocks or bushes
- f Don't approach snakes when they are seen
- f Wear eye protection if in "spitting cobra country"
- f Familiarize yourself with the types of snakes in the area
- f Don't keep pet snakes

Snakebites

Summary

- f Determine the type of snake involved if possible
- f Assess for envenomation
- f Draw bloodwork early (especially type & crossmatch)
- f Monitor for complications
- f Decide if antivenin needed
 - If used, dilute & administer slowly
 - Usually should pretreat to avoid allergic reaction

