Poison gland and biting mechanism in poisonous snakes
Snakes

• ectothermic reptiles
• belong to the suborder Serpentes
• bears well formed biting apparatus coupled with toxic venoms, products by the poison gland
• less than 300 species may be harmful to human
Non Poisonous Snakes

- Head – Rounded or elliptical
- Fangs - Not present
- Pupils – Rounded
- Anal Plate - Double row
- Bite Mark - Row of small teeth
- Family: Boidae, Uropeltidae, Xenopeltidae, Typhlopidae
Poisonous Snakes

- Head – Triangular or posterior broadened
- Fangs – Present
- Pupils - Elliptical pupil
- Anal Plate - Single row
- Bite Mark - Fang Mark
- Family: Viperidae, Elapidae, Colubridae, Hydrophidae
Poisonous

- Head scales: small
- Large and opening / pit b/w eye & nostril (pit viper)
- Third labial touches eye and nostril shield (cobra)
- No pit or third labial touches eye & nostril shield (krait)

Non poisonous

- Large
- Elliptical
Poisonous

- Fangs: hollow like hypodermic needles
- Teeth: 2 long fangs
- Tail: compressed

Non poisonous

- Short and solid
- Several small teeth
- Not much compressed
The Big Four
Family- Elapidae

Cobras (Keute) - *Naja naja, N. oxiana, N. kabuthia*

**Neurotoxicity** usually predominates.
Family–Elapidae

Common krait (kalach) – *Bungarus caeruleus*
Family- Viperidae
Russell’s viper (Chandra Bora) - *Daboia russelii*
- Family - Viperidae
- *Echis carinatus* (afai) - Saw scaled viper
Two more examples
Family- Colubridae
Indian egg-eating snake
*Elachistodon westermanni*
Family- Hydrophidae
Sea snake
*Hydrophis bicolor*
Poison apparatus in snakes

Poison glands—

- modified superior labial or parotid glands.
- situated on the either side of the upper jaw
- Sac-like structure
- thickly encapsulated with fibrous tissue
- narrow duct from the anterior end of the poison sacs and passes forward along the side of the upper jaw and loops over itself just in front of the fang.
- capsule supports vascular fibrous septa that separate the glandular substances into secretory pockets.
Poison apparatus in snakes

**Fangs**-

- Snakes eject venoms by their two hollow maxillary teeth called fangs
- Fangs are long sharply pointed and hook like, being extremely hard and calcified with a superficial enamel layer
Poison apparatus in snakes

**Open type:**
furrowed by a groove for the conduction of the venom.

**Closed type:**
Fang becomes almost or totally tubular, hypodermic syringe like structure due to approximation of the groove tips.

**Opisthoglyphodont:**
fangs lie at the back of the maxilla and are of open category.
e.g. Some colubrid snake

**Proteroglyphodont:**
fangs are situated at the front end of the maxilla and are at closed category.
e.g. Cobra, Sea snake

**Solenoglyphodont:**
fangs are movable and turned inside
e.g. Vipers and Rattle snakes

According to the structural differences poison fangs

According to the position of poison fang
Poison apparatus in snakes

Muscles -

1. Diagastric- attached to the squamosal of skull at one end and the articular of the lower jaw. It helps in opening jaws.

2. Sphenopterygoid or Protractor-pterygoid muscle- attached anteriorly to the sphenoid region and posteriorly to the dorsal surface of the pterygoid. It assists in pulling the pterygoid forward.

3. Anterior and posterior temporalis muscle-attached to the side walls of the cranium and lower jaw. They help in closing the lower jaw.
Snake Muscles

- temporalis muscle, anterior part
- digastric muscle
- temporalis muscle, posterior part
- nostril
- sensory groove
- duct of poison gland
- poison gland
- anterior part of temporalis muscle
- trachea
Mechanism of snake bite

- Opening of mouth by contraction of digastric muscle
- Rotation of maxilla bone
- Fangs become erect and press the victim
- Mouth closes by the action of temporalis muscles
- Injection of poison is completed
Muscle 1 - Diagastric

Attached to the squamosal of skull at one end and the articular of the lower jaw. It helps in opening jaws.
Muscle 1- Sphenopterygoid

Or Protractor-pterygoid muscle: Attached anteriorly to the sphenoid region and posteriorly to the dorsal surface of the pterygoid. It assists in pulling the pterygoid forward.
Muscle 3 – Temporalis

Attached to the side walls of the cranium and lower jaw. They help in closing the lower jaw.
Snake venom

- Clear, transparent, straw-coloured fluid
- Soluble in water and glycerol
- Acidic in nature and can be precipitated by AgNO₃ and KMnO₄
- Highly complex chemical mixtures that “may contain many proteins, mainly particular enzymes, and strongly basic polypeptides
- The chemical compositions of venoms are known to vary intra-specifically for a number of reasons
Snake venom

• The geographic variation in venom - closely related to diet and thus reasoned that natural selection had directed venom composition to make the venoms most effective against the specific prey types that snakes in separate areas would encounter.

• As a general rule, venoms seem to be either highly toxic (to bring about rapid prey death) or highly proteolytic (presumably to help with chemical digestion).
Snake venom

- It is complex mixture of enzymes, low.mol.wt polypeptides, glycoproteins, metal ions.

<table>
<thead>
<tr>
<th>Component</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serine proteases</td>
<td>haemolysis</td>
</tr>
<tr>
<td>Other proteases</td>
<td>haemolysis</td>
</tr>
<tr>
<td>Phospholipase A2</td>
<td>Myotoxic, Cardiotoxic, Neurotoxic, Increases vascular permeability</td>
</tr>
</tbody>
</table>
Snake venom

- produce paralysis and death by respiratory shock
- rich in basic amino acids
- act at the molecular level by disrupting neuromuscular junctions and hence limit muscle activity
- Low molecular weight – fast diffusion process

- have hemorrhagic effects
- often cause tissue destruction in other body systems - attributed to proteins and digestive enzymes such as phospholipase A2
- Higher molecular weight – slow diffusion process
## Grading Scale for Severity of Snake Bites

<table>
<thead>
<tr>
<th>Degree of Envenomation</th>
<th>Presentation</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. None</td>
<td>Punctures or abrasions; some pain or tenderness at the bite.</td>
<td>Local wound care, no antivenin.</td>
</tr>
<tr>
<td>I. Mild</td>
<td>Pain, tenderness, edema at the bite; perioral paresthesias may be present.</td>
<td>If antivenin is necessary, administer about five vials.*</td>
</tr>
<tr>
<td>II. Moderate</td>
<td>Pain, tenderness, erythema, edema beyond the area adjacent to the bite; often, systemic manifestations and mild coagulopathy.</td>
<td>Administration of five to 15 vials of antivenin may be necessary.</td>
</tr>
<tr>
<td>III. Severe</td>
<td>Intense pain and swelling of entire extremity, often with severe systemic signs and symptoms; coagulopathy.</td>
<td>Administer at least 15 to 20 vials of antivenin.</td>
</tr>
<tr>
<td>IV. Life-Threatening</td>
<td>Marked abnormal signs and symptoms; severe coagulopathy.</td>
<td>Administer at least 25 vials of antivenin.</td>
</tr>
</tbody>
</table>

* Because of their less potent venom, Grade-I copperhead bites are usually not treated with antivenin.

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### Grading the Severity of the Bite

A popular scale for grading the severity of pit viper bites and estimating the antivenin dose is presented in above. It is important to remember that a patient must have serial evaluations, because an envenomation that appears to be mild on presentation can soon exhibit the hallmarks of a severe envenomation. Doses of antivenin must not be reduced for children or small persons, since the amount of venom that needs to be neutralized is the same.
<table>
<thead>
<tr>
<th>HEMOTOXIC SYMPTOMS</th>
<th>NEUROTOXIC SYMPTOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intense pain.</td>
<td>Minimal pain.</td>
</tr>
<tr>
<td>Edema.</td>
<td>Ptosis (drooping eye lid).</td>
</tr>
<tr>
<td>Weakness.</td>
<td>Weakness.</td>
</tr>
<tr>
<td>Swelling.</td>
<td>Paresthesia (often numb at bite site).</td>
</tr>
<tr>
<td>Numbness or tingling.</td>
<td>Diplopia (double vision).</td>
</tr>
<tr>
<td>Rapid pulse.</td>
<td>Dysphagia (swallowing difficulty).</td>
</tr>
<tr>
<td>Ecchymoses (bruising).</td>
<td>Sweating.</td>
</tr>
<tr>
<td>Muscle fasciculation (twitching).</td>
<td>Salivation.</td>
</tr>
<tr>
<td>Paresthesia (oral) (numbness, burning, tingling).</td>
<td>Diaphoresis (profuse sweating).</td>
</tr>
<tr>
<td>Unusual metallic taste.</td>
<td>Hyporeflexia (decreased reflexes).</td>
</tr>
<tr>
<td>Vomiting.</td>
<td>Respiratory depression.</td>
</tr>
<tr>
<td>Confusion.</td>
<td>Paralysis.</td>
</tr>
<tr>
<td>Bleeding disorders.</td>
<td></td>
</tr>
</tbody>
</table>
First aid for snake bite

- Call medical help immediately if possible.
- Remain calm, remember most snake bites are not fatal.
- Minimise movement if possible. If you are hiking alone you may have to hike out for help.
First aid for snake bite

• If you are bitten on the arm or finger remove any rings, bracelets or watches. Loosen any tight clothing in case swelling occurs.

• Apply a pressure bandage to the bitten limb. If the bite is to the trunk, head or neck, apply firm pressure to the bitten area. Do not restrict chest movement as breathing will be affected by this.
First aid for snake bite

• Splint or use a sling on the bitten limb to restrict movement.

• If there is no bandage or equivalent to apply a pressure bandage make note of any inflammation by tracing the edge of the swelling with a pen or the like near/around the bite and mark the time clearly next to it. If it progresses make a new tracing noting the time of each new mark beside that new tracing. This will give valuable information to medical help as to the development of the swelling.
First aid for snake bite

• If possible, lie down and keep the bitten extremity at body level. Raising it can cause venom to travel through the body quicker. Holding it down, can increase swelling.

• When possible arrange for transport to the nearest hospital emergency room, where anti-venom for snakes common to the area will often be available and given if required.
• NO aspirin or other pain relievers.

• NO tourniquets. This cuts blood flow completely and may result in loss of the affected limb.

• DO NOT try to suck the venom out of the wound or cut into the bite with a knife. Such measures have not been proven useful and may cause further injury (see below explanation).
NO NO

• DO NOT apply a cold compress or ice on the bite. Research has shown this to be potentially harmful.
• DO NOT raise the wound above the heart. Raising it can cause venom to travel into the body. Holding it down, can increase swelling.
• DO NOT use electric shock or a stun gun on the bite area. This method is under study and has yet to be proven effective. It could harm the victim.
• DO NOT wash the snake bite area - Australian recommendations for snake bite treatment **strongly recommend against** cleaning the wound. Traces of venom left on the skin/bandages from the strike can be used in combination with a snake bite identification kit to identify the species of snake. This speeds determination of which anti-venom to administer in the emergency room.

• DO NOT try and capture the snake. If it's safe you can try to take a photo with a camera or with your phone. This is the best way in aiding snake identification.
Effects of envenomation
<table>
<thead>
<tr>
<th>FEATURE</th>
<th>Cobra</th>
<th>Krait</th>
<th>Russells viper</th>
<th>Saw scaled viper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local pain / tissue damage</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Ptosis/Neurological signs</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Hemostatic abnormality</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Renal failure</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Response to Neostigmine</td>
<td>YES</td>
<td>NO?</td>
<td>NO?</td>
<td>NO</td>
</tr>
<tr>
<td>Response to ASV</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
Conclusion

- Snake bites are treated with antisera raised inactivated snake venom.
- Poison is effect less on the members of same genus but one genus members poisonous to others genus.