

Envenomations – Arthropod bites and stings

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VENOMOUS INSECTS

There are 3 orders of toxicological importance in class insecta:

- *Hymenoptera,*
- *Lepidoptera and*
- *Coleoptera.*

Hymenoptera

- *Two-winged flies and ants*
- *Bees, wasps, yellow jackets, hornets, and fire ants.*

Hymenoptera

Hymenoptera stings are invariably caused by the

- *Honeybee** (*Apis mellifera*),
- *Paper wasp* (*Polistes annularis*; *Ropalidia gregaria*)
- *European wasp* (*Vespula germanica*),
- *Hornets* (*Vespa* & *Dolichovespula* species)
- *Yellow jackets* (*Vespula pensylvanica*) (Fig 12.36).
- *A few incidents result from stings of fire ants* (*Solenopsis invicta*) *and rarely, jumper ants* (*Myrmecia pilosula*).



Fig 12.33: Honey bee (*Apis mellifera*)



Fig 12.34: Paper wasp (*Polistes annularis*)



Fig 12.35: Hornet (*Vespa crabro*)



Fig 12.36: Yellow jacket (*Vespa pensylvanica*)



Fig 12.37: Fire ants (*Solenopsis invicta*)

Venom

- *Venom is usually injected through a sting which may be barbed (e.g. bee), or smooth (e.g. wasp).*
- *Bees inject approximately 50 mcg of venom which is the total capacity of the venom sac, and leave behind the stings embedded in the skin.*
- *Wasps and hornets are capable of repeated stings.*
- *Ants generally bite firmly with their jaws and then sting or spray locally irritating venom.*
- *Fire ants have well developed abdominal stingers and inflict multiple stings.*

Venom

Hymenoptera venom is a mixture of

- Biogenic amines (histamine, 5-hydroxytryptamine and acetylcholine),*
- Enzymes (phospholipase A and hyaluronidase), and*
- Toxic peptides (kinins in wasps; apamin, melittin, and mast cell degranulating peptides in bees).*

Composition of Hymenoptera Venom

Vespids (*Wasps, hornets, yellow jackets*)

Biogenic amines

Phospholipase A & B

Hyaluronidase

Antigen 5

Acid phosphatase

Kinin

Apids (*Honey bees*)

Biogenic amines

Phospholipase A

Hyaluronidase

Acid phosphatase

Minimine

Mellitin

Apamin

Mast cell degranulating peptide

Formicids (*Fire ants*)

Biogenic amines

Phospholipase

Hyaluronidase

Piperidines

MOA

Local Reaction

- *Pathology is similar to other immunoglobulin E (IgE)–mediated allergic reactions.*
- *Anaphylaxis may occur and is typically a result of sudden systemic release of mast cells and basophil mediators.*

Clinical Features

Local Reaction

- *Vasoactive amines and peptides-local **pain, redness, irritation, itching, and swelling**, which resolve in a few hours.*
- *If the site of the sting is in a vital location, e.g. mouth or tongue (**oedema leading to airway obstruction**), or near the eye (**cataract formation, glaucoma, etc.**).*
- *External eye stings can cause **pain, swelling, lacrimation, hyperaemia, and conjunctival chemosis**.*
- *Corneal stings can cause **corneal oedema, ulceration, hyperaemia, pain, scarring, and linear keratitis**.*

Clinical Features

Local Reaction

- *Severe cutaneous infection and cellulitis* have occurred after stings from yellow jackets and wasps, which may pick up *virulent bacteria* while foraging on decaying animal and vegetable matter.

Clinical Features

Allergic Reactions

- *About 4% of the human population is hypersensitive to hymenoptera venom.*
- *Anaphylaxis is IgE-mediated*
- *IgE antibodies attach to tissue mast cells and basophils in a previously sensitised individual.*
- *These cells are then activated, resulting in the progression of the cascade reaction of increased vasoactive substances such as leukotrienes, eosinophil chemotactic factor-A (ECF-A), and histamine.*

Clinical Features

Allergic Reactions

- Clinical features develop within a few minutes of the sting, comprising tingling sensation of scalp, flushing, dizziness, visual disturbances, syncope, abdominal cramps, vomiting, diarrhoea, dry cough, wheezing, and tachycardia.
- In severe cases, the patient develops urticaria, angioedema, glottic oedema, profound hypotension, and coma
- Hypertension has occurred in children with multiple bee stings, and in adults with multiple wasp stings.
- Apnoea, respiratory insufficiency and / or cardiopulmonary arrest have been reported in patients who became comatose after receiving multiple stings

Clinical Features

Allergic Reactions

- *Death may occur within minutes.*
- ***Delayed Reaction:*** *A few patients develop urticaria, skin rash, pedal oedema, and arthritis between 1 to 5 days after the sting.*
- *Sometimes, a **serum sickness–like syndrome** occurs a week or more after the sting. This is characterised by malaise, fever, headache, urticaria, lymphadenopathy, and polyarthritis.*
- ***Renal failure*** *may occur rarely.*

Toxic Reactions

- **Multiple stings**- Vasodilation, hypotension, oedema, fatigue, vomiting, diarrhoea, headache, seizures, and coma. There have been reports of **acute renal failure**.
- **Delayed toxic reactions**- Haemolysis, coagulopathy, thrombocytopenia, rhabdomyolysis, liver dysfunction, and disseminated intravascular coagulation.
- **Fire ants** can cause severe local reaction and even **fatal allergic reaction** (especially in young children).

Laboratory Diagnosis

Intradermal skin tests(to assess sting allergy):

venoms are diluted to concentrations in the range of 0.001 mcg to 1 mcg/ml.

- A positive test is manifested by a specific wheal and flare reaction.*

The radioallergoabsorbent test (RAST) :

“in vitro” method that measures the quantity of venom-specific antibodies in the patient’s serum

Treatment

LOCAL REACTION:

Local cold compresses:

- Application *of ice pack at the sting site* for 15 minutes every 30 minutes
- Scraping away of retained stinger with scalpel blade. (in bee sting)
- Antihistamines: diphenhydramine (50 mg Q6H) Or chlorpheniramine (4 mg Q6 H)
- *Local infiltration with adrenaline 1:1000 (0.1–0.3 ml) near the sting site may help impede systemic absorption of venom.*

Treatment

Allergic reactions

- *0.1% adrenaline 0.5 to 1 ml S.C/I.M*
- *Antihistamine injection (diphenhydramine 50 mg parenterally, then 25 to 50 mg orally every 4 to 6 hours for 24 to 72 hours)*
- *Oxygen—5 to 10 L/min via high flow mask*
- *Bronchodilators such as salbutamol to relieve dyspnoea and wheezing.*
- *Corticosteroids:— Methylprednisolone—1 to 2 mg/kg IV every 6 to 8 hours*

Treatment

Toxic Reactions

- *Parenteral antihistamines*
- *Large doses of corticosteroids*
- *Bronchodilators*
- *Haemodialysis for renal failure*

Venomous arachnids

- *Arachnids differ from insects mainly in the number of legs they possess: eight instead of six.*

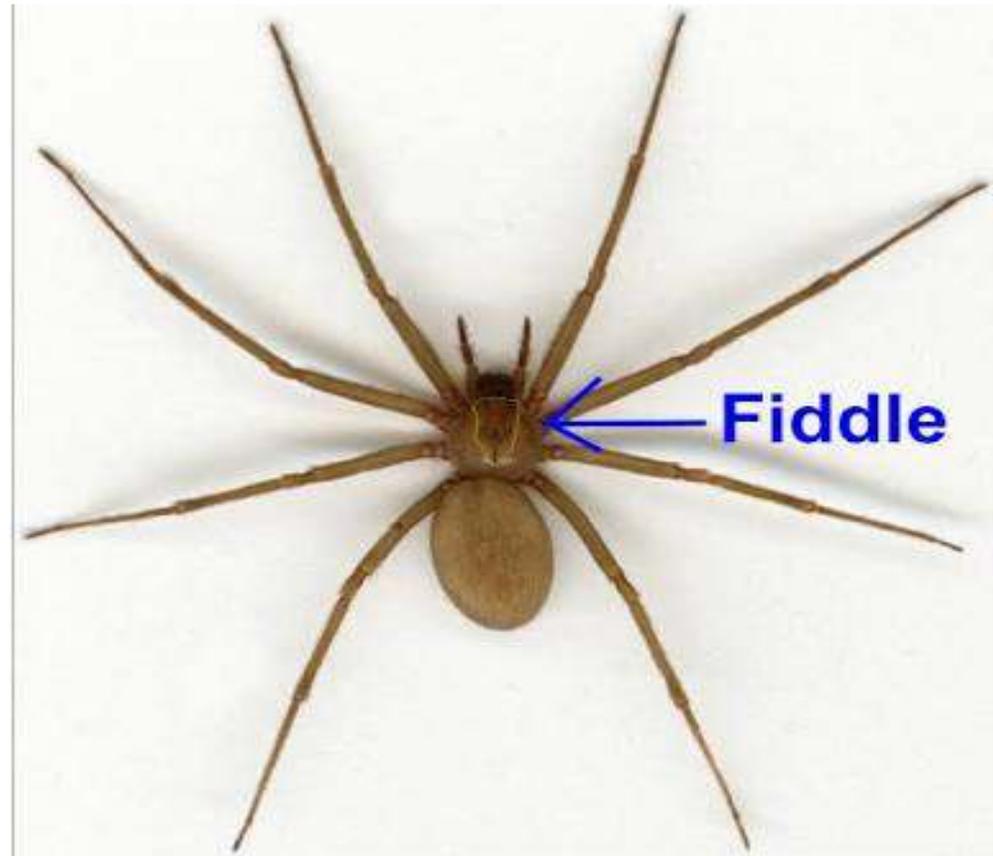
There are two important orders from the toxicological point of view:

- *Scorpionida*
- *Aranea(spiders)*

ORDER ARANEA

The common Indian spider species that cause serious envenomation include

- *Brown Recluse*
- *Black Widow*
- *Wolf Spider*
- *Tarantula.*



Brown recluse (violin, brown spider, Fiddleback)



Fig 12.46: Brown recluse

- *Species: Loxosceles reclusa*

Venom

- *Consists of several toxic components including hyaluronidase, ribonuclease, deoxyribonuclease, alkaline phosphatase, lipase, and sphingomyelinase D.*
- *Sphingomyelinase D reacts with sphingomyelin in the RBC membrane causing the release of choline and N-acylsphingosine phosphate.*
- *This causes severe intravascular occlusion of micro-circulation leading to necrosis.*

Brown recluse (violin, brown spider, Fiddleback)

Venom

- Act *as proteases upon molecular constituents of plasma extracellular matrix* (fi bronectin and fi brinogen), and basement membrane constituents (entactin and heparin sulfate proteoglycan)
- By *disrupting the subendothelial basement membrane*, blood vessel wall instability *and increased permeability* can occur

Clinical features

LOCAL

- Bite is usually *painless, begins to bleed* and ulcerate in 2 to 8 hours.
- Erythema and pain or pruritus.
- A small vesicle may form at the bite area, and the lesion may take on a *“bullseye” or “halo” appearance*
- Ulcerated lesions if untreated, usually enlarge until about a week when *eschar formation* takes place

Day 5



Day 8



Day 14



Day 21



Day 28



Day 56



SYSTEMIC (“loxoscelism”)

- ***Fever** associated with chills and night sweats myalgia, arthralgia, headache*
- *Vomiting, haemolysis, **DIC, shock, renal failure**, jaundice, convulsions and coma.*
- ***Acute tubular necrosis** with resulting oliguria or anuria*

Diagnosis

- *Leucocytosis (20,000 to 30,000 per cubic mm).*
- *Prolonged PT and PTT*
- *Coombs positive*
- *Haemolytic anaemia.*
- *Abnormal renal and liver function tests.*

Treatment

LOCAL

- *Wound cleansing.*
- *Immobilisation of bitten extremity.*
- *Tetanus prophylaxis.*
- *Analgesics*
- *Application of cold compresses*
- *Antipruritics: Diphenhydramine 5 mg/kg/day orally, with a maximum dose of 25 to 50 mg four times a day.*
- *Antibiotics, if wound gets infected.*

Treatment

SYSTEMIC

- *Admit patient to hospital and monitor for evidence of haemolysis, coagulopathy and renal failure.*
- *If haemoglobinuria occurs, renal failure may be prevented by **increasing IV fluids, and alkalinising urine.***
- *Significant **haemolysis** should be treated with transfusions*

Black Widow (Hourglass spider)

- *Latrodectus species*

VENOM

Neurotoxic

*Main component: **alpha latrotoxin** (binds avidly to a specific presynaptic receptor.)*



Black Widow(Hourglass spider)

VENOM

- *The venom affects the motor endplates of neuromuscular synaptic membranes by the binding of gangliosides and glycoproteins at the synapses.*
- *This causes the channels for sodium influx into neurons to remain open, as a result of which there is extensive release of acetylcholine and noradrenaline into the synapses, thereby inhibiting reuptake.*
- *The end result is massive stimulation of motor endplates as the venom travels through the lymphatic system*

Clinical Features (Latrodectism)

GRADE 1

- *Sharp pain at bitesite, which may have one or two small puncture wounds, 1 to 2 mm apart.*
- *The immediate area may be warm, mildly indurated, and slightly reddened.*

GRADE 2

- *Muscular pain in bitten extremity extending to the trunk.*
- *Local diaphoresis of bitten extremity.*
- *Tender regional lymphadenopathy may be present.*

GRADE 3:

- *Generalised muscle pain and weakness, with difficulty in walking.*
- *Generalised sweating.*
- *Tachycardia and hypertension*
- *ECG changes : QRS with ST and T segments depression, prolonged QT interval.*
- *Priapism, urinary retention, pyuria, proteinuria, microscopic haematuria, and testicular pain*
- *Nausea, vomiting, and headache.*
- *Victim often displays a contorted, grimacing, sweating facial appearance, referred to as “facies latroductismica”.*
- *Ptosis , salivation, hyperreflexia, tremor, convulsions, tachypnoea, and respiratory compromise.*
- *Board-like rigidity of the abdomen, shoulders, and back may develop.*
- *Acute renal failure is uncommon but reported*

Diagnosis

- *Leucocytosis*
- *Elevated creatine kinase*
- *Albuminuria.*

Treatment :

- *Pain-IV Morphine / pethidine + benzodiazepines*
- *Application of cold or warm compresses*
- *Swelling-non-steroidal anti-inflammatory drugs.*
- *Muscle relaxants such as diazepam, dantrolene may help relieve muscle spasm.*
- *Tetanus prophylaxis is essential.*
- *Milder pain treated with aspirin, paracetamol, and / or codeine.*

Wound care:

- a. Cleansing with antiseptics.*
- b. Immobilisation, elevation, and serial observation.*
- c. If infection sets in, antibiotics must be administered.*
- d. Surgical intervention (excision) may be necessary if lesion exceeds 4 cm at 12 hours post-envenomation*

Wolf spider

- *Lycosa species.*

Clinical features

LOCAL:

Generally no serious manifestations

- Occasionally it causes moderate *pain, erythema, oedema, or pruritis*

SYSTEMIC (develops after 1-2 days): fever, chills, myalgia, and arthralgia

Treatment

Supportive and symptomatic measures.



Tarantulas (*Lycosa tarantula*)

Variant of wolf spider

- *Commonest species involved in bites is *Dugesiella hentzi**

Clinical features:

- *Hairs* of the tarantula may cause *urticaria and conjunctivitis* on contact
- Bites can be *painless, or produce a deep, throbbing pain* for an hour
- *Local swelling may develop.*

Treatment :

- *Application of ice packs*
- *Wound cleansing*
- *Antihistamines*



Fig 12.48: Tarantula

- *Immobilisation of the affected part,*
- *Elevation, systemic analgesics and supportive care usually suffice.*
- *Tetanus prophylaxis may be required.*



ORDER SCORPIONIDA

SCORPION STINGS



- *The members of this order comprise **scorpions***
- *There are at least **650 different types** of scorpions divided into **6 families**.*
- *Most species are nocturnal, and seek areas that are cool and moist.*
- *The scorpion has a cephalothorax (fused head and chest), an abdomen, and a six segmented tail which terminates in a **bulbous enlargement called telson***
- *The **telson** contains the stinger and **venom apparatus***



Fig 12.40: Black scorpion (*Palamnaeus gravimanus*)



Fig 12.39: Red scorpion (*Mesobuthus tamulus*)

- *The commonest Indian species: merobuthus tamulus (red scorpion)*

VENOM

- *The main toxins include phospholipase, acetylcholinesterase, hyaluronidase, serotonin, and neurotoxins.*
- *The venom of Buthus species of India contains phospholipase A, which causes gastrointestinal and pulmonary haemorrhages, and disseminated intravascular coagulation.*



Mode of action

- *Most scorpion venoms affect sodium channels with prolongation of action potentials, as well as spontaneous depolarization of nerves of both adrenergic and parasympathetic nervous systems. Thus, both adrenergic and cholinergic symptoms occur.*
- *Hyperkalaemia, hyperglycaemia (with reduction in insulin secretion), and increased secretion of renin and aldosterone are characteristic of stings by *Mesobuthus tamulus**

Clinical features

LOCAL

SYSTEMIC

Excruciating pain, swelling, redness

Mydriasis, profuse sweating

Urticaria, salivation, priapism,

Hypertension, brady- / tachyarrhythmias

Pulmonary edema leading to death

Intracerebral hemorrhage resulting in hemiparesis

Convulsions

Hyperglycemia, hypertension

Palamnaeus species causes local pain, paraesthesias, mild autonomic nervous system excitation, pulmonary infiltration, eosinophilia, salivation, nausea, sweating, and mild hypotension.

Scorpion sting—sweating, mydriasis



Salivation due to scorpion sting



TREATMENT

During transport to hospital:

- Immobilise the stung limb (*do not apply tourniquet*)
- Local ice application

On arrival at hospital

- Admit all patients with systemic manifestations (hypertension, hypovolaemia, pulmonary oedema) to ICU
- Patients with respiratory failure or with CNS disturbances should *be mechanically ventilated; administer oxygen* to all serious cases
- Pain-paracetamol/morphine
- Diazepam for convulsions
- Metoclopramide for vomiting-5-10 mg IV



Fig. 7 : Tight tourniquet may result in gangrene

- *Mild to moderate* antihistamines, with or without inhaled beta agonists, corticosteroids, or adrenaline.
- *Severe anaphylaxis* must include *oxygen supplementation, aggressive airway management, adrenaline, ECG monitoring, and IV fluids.*
- Hypertension(160/110 mmhg)-*nifedipine* 10-20 mg every 4hrs-6hrs, child dose - 0.3mg/kg
- Hypotension-dopamine infusion: 2-5mcg/kg/min
- Furosemide/prazosin for pulmonary oedema.
- Life-threatening pulmonary oedema may respond to a *nitroprusside drip*

- *Agitation and convulsions can be controlled with IV diazepam (5 to 10 mg, adults; 0.2 to 0.3 mg/kg, children; repeated every 10 minutes as required).*
- *Alternatively, phenobarbitone can be given, 5 to 10 mg/kg IV.*
- *Persistent vomiting usually responds to metoclopramide 5 to 10 mg IV (adults), or 0.5 mg/kg (children).*
- *Persistent tachyarrhythmias can be reversed with **propranolol** (1 mg/dose IV, administered no faster than 1 mg/min, repeated every 5 minutes until desired response is seen, or a maximum of 5 mg has been given).*

Anti venom therapy

- *Scorpion antivenom effective against Mesobuthus tamulus has recently been introduced in India.**
- *The recommended dose is 1 vial (reconstituted in 10 ml of injection water) initially, followed by further doses if required.*

Thank you