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A CRITICAL REVIEW ON INSECTS WITH SPECIAL REFERENCE TO TOXICOLOGY REVIEW ARTICLE

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ABSTRACT

Toxinology is the specialized area of toxicology that deals specifically with animal, plant and microbial toxins, but is also considered a science in its own right. Prof. Dietrich Mebs has defined toxinology as "the scientific discipline dealing with microbial, plant and animal venoms, poisons and toxins" The term *Keeta* is usually correlated with the insects, they are considered first. Arthropods, the largest phylum includes - Hexapods: true insects, Myriapods: Millipedes and centipedes, Arachnidae: Mites, ticks, spiders, scorpion. Insects make up 90% of the animal kingdom; there are over three million species of insects. All the insects come under phylum Arthropoda. The Orders that contain the greatest number of species are Coleoptera (beetles), Lepidoptera (butterflies and moths), Hymenoptera (anta, bees, wasps) and Diptera (true flies). Discoveries of insect fossils show that insects have been found for at least *the last* 350 million years. General introduction of Insects, Entomophagy, Insect bites and stings, Pathogenesis, general signs and symptoms, Allergic effects, Histopathology in insect bites, honey bee sting and its treatment is included briefly.

KEYWORDS: *Ayurved*, *Agadatantra*, Toxinology, *Keeta*, Insects, honey bee sting.

INTRODUCTION

Toxinology is the specialized area of toxicology that deals specifically with animal, plant and microbial toxins, but is also considered a science in its own right. Prof. Dietrich Mebs has defined toxinology as "the scientific discipline dealing with microbial, plant and animal

venoms, poisons and toxins"[1] and pointed out that "toxinology includes more than just the chemistry and mode of action of a toxin. It deals also with the biology of venom- or poison-producing organism, the structure and function of the venom apparatus as well as the use of the venom or poison, the ecological role of these compounds." Prof. Jurg Meier has defined toxinology as "the science of toxic substances produced by or accumulated in living organisms, their properties and their biological significance for the organisms involved".[2]

More than a million species of multicellular animals have been described in the global fauna; several million yet to be discovered. Comparable numbers of species have existed in the past and become extinct, leaving only a remnant indication of their presence in the fossil record. Almost all these animals are invertebrates. The diversity of vertebrate life is limited to less than 50,000 species living and some equivalent number extinct. Vertebrate diversity is based on modifications of a single body plan while invertebrate diversity includes about 30 body plans each characterising a distinctive animal group or phylum each with its own range of diversity.

These body plans exhibit several organisational levels ranging from simple to complex:
Non-symmetrical, with a cellular construction (Porifera)
Radially symmetrical, with a tissue construction (Cnidaria, Ctenophora)
Bilaterally symmetrical, with an organ construction
Acoelomate: unsegmented (Platyhelminthes, Nemetra, Entoprocta, Gnathostomulida)
Pseudocoelomate: unsegmented (Nematoda, Nematomorpha, Gastrotricha, Kinorhyncha, Rotifera, Loricifera, Acanthocephala, Priapula
Coelomata: unsegmented (Sipuncula), trimeric (Echinodermata, Chordata, Hemichordata, Chaetognatha, Phoronida, Brachipoda,Ectoprocta) or metameric (Annelida, Echiura, Pogonophora, Vestimentifera)
Haemocoelic: unsegmented (Mollusca) or metameric (Onychophora, Tardigrada, Arthropoda)

All these animals are definable as metazoans. They are multicellular animals with a significant degree of cellular differentiation. Their epithelial cells are joined by septate or tight junctions, a fact of importance in providing continuous epithelia at body surfaces. They have collagen as a component of an intercellular matrix and share an intercellular communication mechanism based on acetylcholine and cholinesterase.

An attempt to introduce the creatures described in the context of *Keeta Visha* with emphasis on their envenomation is done here.

The term *Keeta* is usually correlated with the insects, they are considered first.

Arthropods, the largest phylum includes --

Hexapods: true insects

Myriapods: Millipedes and centipedes

Arachnidae: Mites, ticks, spiders, scorpion.

Insects[3]

Insects make up 90% of the animal kingdom; there are over three million species of insects. All the insects come under phylum Arthropoda. The Orders that contain the greatest number of species are Coleoptera (beetles), Lepidoptera (butterflies and moths), Hymenoptera (anta, bees, wasps) and Diptera (true flies).

Insects take advantage of all types of habitats. They associate themselves with plants (as leaf feeders, borers, miners, gall makers and decomposers) and animals (as predators, parasites, blood suckers, scavengers and decomposers). Discoveries of insect fossils show that insects have been found for at least *the last* 350 million years.

Kingdom:	Animalia
Phylum:	Arthropoda
Subphylum:	Mandibulata
Superclass:	Hexapoda
Class:	Insecta Linnaeus, 1758
Subclasses	
Monocondylia (Archaeognatha) Dicondylia Apterygota Pterygota	

Insects (from Latin *insectum*, a calque of Greek ἔντομον [*éntomon*], "cut into sections") are a class within the arthropods that have a chitinous exoskeleton, a three-part body (head, thorax, and abdomen), three pairs of jointed legs, compound eyes, and two antennae.

There are more than 30 different scientific groupings of insect types. Above these groupings, there are six main categories of bugs that all insects fall into.

- **Insects** have a pair of antennae and compound eyes. They are hatched from eggs, and undergo metamorphosis at some point to achieve their adult form. Insects and arachnids fall into the category called arthropods, but they are separate divisions under that category. Arachnids include spiders, ticks and other eight-legged creatures. They have their own category because they've got eight legs, while all insects have six.
- **Flies** include the housefly, mosquito, tsetse fly and stable fly. These creatures lay eggs in garbage, manure or water. Every creature in this category has a pair of wings and can fly. They hatch from their eggs into a larval stage where the creature resembles a small worm. From that stage, they grow into adults.
- **Dragonflies** are an ancient group of flies that has thin, needle-like bodies and two sets of wings that are layered. Dragonflies and damselflies are carnivores that primarily eat mosquitoes and other small insects. These creatures lay their eggs in water, then spend the first part of their lives as water-dwelling nymphs.
- **Butterflies and moths** have two pairs of wings and suck flower nectar with long, straw-like mouth tubes called probosces. Butterflies are active during the day, while moths are nocturnal. These creatures hatch from eggs and grow into caterpillars. The caterpillars then create a coccoon and transform into adult moths and butterflies. Most moths and butterflies only live for a few days, but those inhabit northern areas with a scarce supply of nectar may live for more than a year.
- **Beetles** have round bodies and two pairs of wings. The outer wings form a hardened, protective shell for the inner wings. Beetles can fly just as well as they can walk, unlike flies, which typically use their legs for very short walks or grasping. Beetles range from the benevolent, such as the aphid-eating ladybug, to the destructive, such as the Asian Longhorn Beetle, which can kill trees. Beetles hatch from eggs into caterpillar-like grubs. As they grow, the grubs shed their skin and the adult form slowly emerges.
- **Bugs** include the bedbug, water bug, stink bug and cicada. Some bugs hop, some bugs fly. Some burrow, some live on ponds. The one thing they all have in common are mouthparts that can pierce their food source and extract juices from it.
- **Ants, bees and wasps** live and work in colonies that are cooperative in nature. They are social, working together for the good of the whole. Each member of the colony has a specific type of job. These creatures use movement and chemical signals to communicate. A single queen in the colony lays thousands of eggs that hatch as miniature versions of the adults. While bees and wasps always have wings, ants only develop them when it is time for a colony to expand.

Many insects are considered pests by humans. Insects commonly regarded as pests include those that are parasitic (mosquitoes, lice, bed bugs), transmit diseases (mosquitoes, flies), damage structures (termites), or destroy agricultural goods (locusts, weevils).

Entomophagy

In some parts of the world, insects are used for human food, while being a taboo in other places. There are proponents of developing this use to provide a major source of protein in human nutrition.

Insects are also used in medicine, for example fly larvae (maggots) were formerly used to treat wounds to prevent or stop gangrene, as they would only consume dead flesh.

Despite the large amount of effort focused at controlling insects, human attempts to kill pests with insecticides can backfire. If used carelessly the poison can kill all kinds of organisms in the area, including insects' natural predators such as birds, mice, and other insectivores.

Insect bites and stings

Insects usually become pathological by bites, stings and contacts to body. Insect poisoning causes physical trauma, injection of venom or allergy and sensitivity reactions. This leads to formation of firm papules or pigmented macules or bullous /ulcerative lesions, secondary infections, transmission of diseases, irritation, cellulitis and lymphangitis.[4]

Most of the insects are neurotoxic, some are vasculotoxic and some cause allergies. Spiders are more vasculotoxic and cause may severe inflammatory reactions. Scorpions are predominantly neurotoxic. All other insects cause practically mild forms of neurotoxic, vasculotoxic or allergic reactions.

Insect bites and stings occur when an insect is agitated and seeks to defend itself through its natural defense mechanisms, or when an insect seeks to feed off the bitten person.

Mouth parts of the biting insect can be classified into three broad groups- piercing, sponging and biting. A sting or bite injects venom composed of proteins and other substances that may trigger an allergic reaction in the victim and also cause redness or swelling at the site. Even the non-venomous insects inject saliva which aid in digestion, inhibit coagulation, increase blood flow to the site or anaesthetize the bite locus. Most lesions are the result of the victim’s immune response to these secretions. Many of the bites are minor and can result in superficial

puncture wounds to the skin. Some insects inject formic acid, which can cause an immediate skin reaction often resulting in redness and swelling in the injured area.

Pathogenesis

Bites of insects will deposit the poisonous substance at the bite spot. It includes several enzymes.

Serotonin which is a neurotoxin is the most important. It will stimulate and irritate the nerve endings causing severe burning pain.

The necrolytic enzymes present will cause inflammation due to which there will be formation of granulation tissue at the bite spot. Depending upon the severity of inflammation and extend of tissue necrosis this granulation tissue may be large and hard.

Some insects will release histamines in the body which will cause allergic manifestations like sweating, urticaria and even anaphylactic shock.

Some envenomation will lead to the development of sensitivity resulting in the production of sensitized lymphocytes. By this the body becomes sensitive and results in delayed type of allergic manifestation.

The reaction to a sting is of three types.

- The normal reaction involves the area around the bite with redness, itchiness, and pain.
- A large local reaction occurs when the area of swelling is greater than 5 cm.
- Systemic reactions are when symptoms occur in areas besides that of the bites.

The skin reaction to insect bites and stings usually lasts for up to a few days. However, in some cases the local reaction can last for up to two years. These bites are sometimes misdiagnosed as other types of benign or cancerous lesion.

Clinical effects[4] can be broadly divided into- Fright effects and Venom effects.

They may be

Local- Mainly vasculotoxic –pain, swelling, necrosis etc.

Systemic- Vasculotoxic (bleeding, shock etc.)

Neurotoxic- autonomic effects, neuromuscular block of muscles. (for vision, swallowing, breathing etc.)

Myotoxic

General Signs and symptoms

Practically mucocutaneous lesions are commonly seen. Insect bites and stings cause itchy papules. Some causes superficial skin lesions, deeper skin lesions, infestations in wounds etc. Less commonly systemic cardio toxic or myotoxic.

Their bites typically produce a wheal and later a puritan papule. The signs and symptoms include pain, swelling, redness and itching to the affected area. The skin may be broken and become infected if the area is scratched. If not treated properly, these local infections may become severe and cause cellulitis, if infected there will be redness with or without pus, warmth, fever or a red streaks that spread towards the body.

Stings from large hornets or multiple bee stings have reported to cause muscle breakdown and kidney failure.

In certain cases, insects get crushed on the skin and produce cutaneous lesions. First wheal and blisters; most commonly kissing lesions, where secondary infection followed by ulceration when a blister encounters another area of the skin follows. Beetles and spiders are common examples.

Bites from mosquitoes and fleas are more likely to cause itching than pain**.**

Allergic effects

Local reactions to insect venom may cause extensive swelling around the site lasting as long as seven days, but usually do not require specific treatment. Generalized reactions vary from mild to life threatening. Toxic reactions to venom after multiple (50-100) simultaneous stings may mimic anaphylaxis. A severe reaction beyond the immediate area of the sting/ bite is anaphylaxis. The symptoms include hives, wheezing shortness of breath, unconsciousness and even death within 30 minutes. A sting on the tongue may cause throat swelling and death because of airway obstruction.

In addition, exposure to large amounts of insect venom frequently stimulates the production of IgE antibodies and thus may be followed by allergic reactions to single stings. Unlike insect stings, insect bites rarely cause anaphylaxis. Antigen specific immunotherapy with bee

or wasp venom reduces the incidence of recurrent anaphylaxis from 50-60%to 10% after two years of treatment.[5]

Mosquitoes, ants, gnats, midges and flies are clinically very significant. The clinical features of their bites vary with the active substance injected and degree of acquired allergic sensitivity. Most of them will cause immediate and delayed type of allergic reaction. Often cutaneous wheal, itching and urticaria may develop. Nodular lesions at the site of midge bite may last for months. Fleas-usually produce cutaneous reaction as bullous papule, papule centered by a haemorrhagic punctum; the lesions are characteristically grouped in lines or irregular clusters on the thighs, buttocks and lower abdomen, arms and forearms. The bite of small hump backed black fly of the genus Simulism leaves a large bleeding puncture and painful and pruritic sores that are slow to heal. Regional lymphadenopathy, fever or analphyxis occasionally ensues. Deerflies (Chrisoms species) and horse flies (Tabanus species) are stout flies that produce large and painful bleeding punctures. Tsetse fly of the genus Glosssina transmit African trypanosomiasis.

The sting from fire ants, bees, wasps and hornets are usually painful, and may stimulate a dangerous allergic reaction called anaphylaxis for at-risk patients, and some wasps can also have a powerful bite along with a sting. The stings of these induce immediate burning pain which may be very severe and is rapidly followed by swelling and redness. Severe hypersensitivity reactions lead to death by shock.

Hives are the most common systemic sign. They appear as irregular raised, red blotchy areas on the skin and are very itchy.

Infection or signs of anaphylaxis, like wheezing, shortness of breath, chest tightness or pain sensation of the throat, closing or difficulty in speaking or swallowing, faintness or weakness require urgent medical attention.

Examination of the skin, respiratory system, cardiovascular system, and oral cavity are particularly important.

Histopathology in Insect bites

Delayed Reactions

- Diffuse dermal infiltrate
- Increased lymphocytes

- Later increased plasma cells.

Immediate type

- Sensitivity develops, eosinophils appear and gradually becomes predominant.
- Bullous reaction develops beneath a more or less intact epidermis
- Chronic reactions persisting for months or years show delayed changes with increased histiocytes and plasma cells
- Secondary lymphoid follicles and germinal centres are sometimes formed
- If retained mouth parts are present there may be giant cells of foreign body type
- Acanthosis and hyperkeratosis seen.

Microscopic appearance

The histomorphologic appearance of insect bites is usually characterized by a wedge-shaped superficial dermal perivascular infiltrate consisting of abundant lymphocytes and scattered eosinophils. This appearance is non-specific, i.e. it may be seen in a number of conditions including:

- Drug reactions,
- Urticarial reactions,
- Prevesicular early stage of bullous pemphigoid, and
- HIV related dermatoses.
- *Anopheles mosquitoes cause yellow fever*

Table showing insects commonly seen as vectors.[3]

Name of the Vector	Parasite	Transmitted disease
Aedes	viruses	Yellow fever, dengue
Anopheles mosquito	Plasmodium	Malaria
Culex	Filarial worm	Elephantiasis
Deer flies	Loa loa worm	Calabar swelling
House fly	Bacilli cholera	Dysentery, Tuberculosis
Rat flea	Bacillus…	Bubonic plague
Sand fly	protozoa	Kala azar, *oriental sores.*
Tsetse fly	trypanosome	Sleeping sickness

Bees, Wasps, and Hornets[5]

Bees are flying insects closely related to wasps and ants, and are known for their role in pollination and for producing honey and beeswax. Bees are a monophyletic lineage within the superfamily Apoidea, presently classified by the unranked taxon name Anthophila. There are nearly 20,000 known species of bees in seven to nine recognized families.

	Bee	Wasp	Hornet
Kingdom	Animalia	Animalia	Animalia
Phylum	Arthropoda	Arthropoda	Arthropoda
Class	Insecta	Insecta	Insecta
Order	Hymenoptera	Hymenoptera	Hymenoptera
Suborder	Apocrita	Apocrita	Apocrita
Superfamily/family	Apoidea: (unranked): Anthophila		Vespidae

These insects abound in many parts of India and other tropical and temperate regions, especially during the flowering season.

A bee sting is strictly a sting from a bee (honey bee, bumblebee, sweat bee, etc). In the vernacular it can mean a sting of a bee, wasp, hornet, or yellow jacket. The stings of most of these species can be quite painful, and are therefore an object of dread for many people. Multiple stings, especially over the face are serious. During the sting the stinger which is the modified ovipositor at the posterior end of the abdomen is inserted into the skin and the venom is discharged. In case of bees the stinger is left behind in the skin and injection of venom continues for a few minutes even after the insect has left. The toxic components include PhospholipaseA_2, histamine, bradykinin, acetyl choline, dopamine, serotonin, mast cell de-granulating peptide, hyaluronidase and mellitins.

Bee stings differ from insect bites, and the venom or toxin of stinging insects is quite different. Therefore, the body's reaction to a bee sting may differ significantly from one species to another.

The most aggressive stinging insects are vespid wasps (including bald-faced hornets and other yellow jackets) but not hornets in general (e.g., the European hornet is gentle). All of these insects aggressively defend their nests.

In people who are allergic to bee stings, a sting may trigger a dangerous anaphylactic reaction that is potentially deadly. Honey bee stings release pheromones that prompt other nearby bees to attack.

Honey bee stings

A honey bee that is away from the hive foraging for nectar or pollen will rarely sting, except when stepped on or roughly handled. Honey bees will actively seek out and sting when they perceive the hive to be threatened, often being alerted to this by the release of attack pheromones.

The sting consists of three parts: a stylus and two barbed slides (or lancets), one on either side of the stylus. Honey bees are the only hymenoptera with a strongly barbed sting, though yellow jackets and some other wasps have small barbs. It is widely believed that a worker honey bee can sting only once but this is a partial misconception: although the stinger is in fact barbed so that it lodges in the victim's skin, tearing loose from the bee's abdomen and leading to its death in minutes, this only happens if the skin of the victim is sufficiently thick, such as a mammal's. The bee does not push the sting in but it is drawn in by the barbed slides.

The sting's injection of apitoxin into the victim is accompanied by the release of alarm pheromones, a process which is accelerated if the bee is fatally injured. Release of alarm pheromones near a hive or swarm may attract other bees to the location, where they will likewise exhibit defensive behaviours until there is no longer a threat, typically because the victim has either fled or been killed. These pheromones do not dissipate or wash off quickly, and if their target enters water, bees will resume their attack as soon as it leaves the water.

The main component of bee venom responsible for pain in vertebrates is the toxin melittin; histamine and other biogenic amines may also contribute to pain and itching. In one of the medical uses of honey bee products, apitherapy, bee venom has been used to treat arthritis and other painful conditions.

The stinger of the Asian giant hornet is about 6 mm (¼ in) in length, and injects an especially potent venom that contains, like many bee and wasp venoms, a cytolytic peptide (specifically, a mastoparan) that can damage tissue by stimulating phospholipase action, in addition to its own intrinsic Phospholipase. An allergic human stung by the giant hornet may die from an allergic reaction to the venom, but the venom contains a neurotoxin called mandaratoxin (MDTX), a single-chain polypeptide with a molecular weight of approximately 20,000 u, which can be lethal even to people who are not allergic if the dose is sufficient.

The venoms of bees and wasps differ from each other even though the main allergic components are common. The composition of the venom may vary seasonally. In the case of allergies to bees most of the antibodies are directed towards phospholipase A_2.

In case of wasp venom antigen 5 is the specific component towards which IgE is directed.

Initial symptoms consist of intense local pain, angio-neurotic edema, respiratory obstruction and anaphylactic shock. Local tissue necrosis, intravascular haemolysis and renal failure

complicate a few cases. Delayed hypersensitivity reactions resembling serum sickness may occur after 2 or 3 weeks. Multiple stings especially over the face are associated with considerable mortality, when death occur with signs of collapse as sweating, fall of blood pressure. There may be nausea and bronchospasm. Wasp stings may cause bilateral Ptosis and other upper cranial nerve palsies which respond to neostigmine, suggesting a myasthenia like reaction (RD Singh et al JI Asso Phys. India, 2003; 51:828-9)

Treatment

First aid

Check the airways and breathing. Reassure the person; try to keep him or her calm. Do not apply tourniquet or give stimulants, aspirin or other pain medication unless prescribed by the doctor. Remove constricting items because the affected area may swell. Hospitalize the patient. Treat the person for signs of shock.

Maintenance of the airway and ventilator support are lifesaving when the oedema obstructs respiration. Injection of adrenaline and corticosteroids and other supportive measures may be required to combat the anaphylactic reaction.

In all cases the local site should be inspected. The first step in treatment following a bee sting is removal of the stinger itself by gentle scraping. The stinger should be removed as fast as possible without regard to method: studies have shown the amount of venom delivered does not differ if the sting is pinched or scraped off and even a delay of a few seconds leads to more venom being injected. Once the stinger is removed, pain and swelling should be reduced with a cold compress.

Treatment depends on the type of reaction. If there is only redness and pain at the site of the bite, application of ice is adequate treatment.

Clean the area with soap and water to remove contaminated particles left behind by the insect. The area should not be scratched as it will only increase the itching and swelling. The sting may be painful for a few hours. Swelling and itching may persist for a week. If a reaction persists for over a week or covers an area greater than 7-10 cm (3 or 4 inches), a tetanus immunization is often recommended.

If the victim is allergic to bee stings, the victim must be treated to prevent shock.

For about 2 percent of people, anaphylactic shock can be life-threatening and requires emergency treatment.

Severe reactions are treated with injections of epinephrine and an antihistamine. IV infusion given, Oxygen administration done and the patient is constantly monitored. After emergency treatment, antihistamines are taken for a short period of 3-5 days. Oral antibiotics and steroids are also prescribed. Specific antisera are available in some countries.

Desensitization therapy may be given afterwards so that severe reaction to future stings may be prevented.

(Many traditional remedies have been suggested for bee stings including damp pastes of tobacco, salt, baking soda, meat tenderizer, toothpaste, clay, garlic, urine, onions, aspirin or even application of copper coins. Bee venom is acidic as it contains the highly acidic peptide melittin, and these interventions are often recommended to neutralize the venom; however, neutralizing a sting is unlikely to be effective as the venom is injected under the skin and deep into the tissues, where a topically applied alkali is unable to reach, so neutralization is unlikely to occur. In any case, the amount of venom injected is typically very small (between 5 and 50 micrograms of fluid) and placing large amounts of alkali near the sting site is unlikely to produce a perfectly neutral pH to stop the pain. The effect is probably related to rubbing the area or the mind perceiving benefit.

Furthermore, none of these interventions have been proven to be effective in scientific studies and a randomized trial of aspirin paste and topical ice packs showed that aspirin was not effective in reducing the duration of swelling or pain in bee and wasp stings, and significantly increased the duration of redness. The study concluded that ice alone is better treatment for bee and wasp stings than aspirin.)

Sensitized persons should avoid further exposure to these insects and wear protective clothing when so exposed. Auto injecting pen syringes loaded with 0.15 or 0.3 mg of epinephrine are available for instant use. People known to be highly allergic may carry around epinephrine in the form of a self-injectable EpiPen for the treatment of an anaphylactic shock.

CONCLUSION

Insects make up 90% of the animal kingdom; there are over three million species of insects. there are six main categories of bugs that all insects fall into **Flies, Dragonflies, Butterflies**

and moths, Beetles, Bugs, Ants, bees and wasps.

Many insects are considered pests by humans. Insects commonly regarded as pests include those that are parasitic (mosquitoes, lice, bed bugs), transmit diseases (mosquitoes, flies), damage structures (termites), or destroy agricultural goods (locusts, weevils). Practically mucocutaneous lesions are commonly seen. Insect bites and stings cause itchy papules. Some causes superficial skin lesions, deeper skin lesions, infestations in wounds etc. Less commonly systemic cardio toxic or myotoxic. Stings from large hornets or multiple bee stings have reported to cause muscle breakdown and kidney failure. Local reactions to insect venom may cause extensive swelling around the site lasting as long as seven days, but usually do not require specific treatment. Generalized reactions vary from mild to life threatening. Toxic reactions to venom after multiple (50-100) simultaneous stings may mimic anaphylaxis. **Examination** of the skin, respiratory system, cardiovascular system, and oral cavity are particularly important.

Treatment depends on the type of reaction. If there is only redness and pain at the site of the bite, application of ice is adequate treatment.

Other management includes Maintenance of the airway and ventilator support are lifesaving when the oedema obstructs respiration. Injection of adrenaline and corticosteroids and other supportive measures may be required to combat the anaphylactic reaction.

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