

1 general

Today there are around 1400 species of scorpions, although estimates of the exact number vary widely. All scorpions are venomous, but only a minority, twenty five or so, are potentially lethal for humans. Scorpions do not bite. Stings by scorpions are fairly common. However, most clinical reports emphasise the serious cases and systematically overestimate the danger these creatures pose. In endemic areas, after all, people don't go to a doctor for minor stings. Fatal stings are essentially limited to Mexico, Brazil, Trinidad, northern Africa, South Africa, the Middle East and India. It is primarily children and patients suffering from a respiratory and/or cardiovascular condition who run a high risk of complications.

2 Biology

Scorpions are the most primitive members of all Arachnida. They have changed little since their first appearance in the Silurian period (395,000,000 years ago). Initially aquatic, they became completely terrestrial at the end of the Devonian period and the beginning of the Carboniferous period (345,000,000 years ago). Today they are exclusively land animals. They live for an average of two to six years. Their life span in nature is primarily determined by predation. Scorpions have an articulated body. In all, there are 18 body segments (somites), the first 6 of which have fused. The head and the thorax are fused to a cephalothorax or prosoma (lit. "fore-body"). Each of these fused segments has a single pair of appendages. At the very front there are small tweezer-like chelicerae, the second segment has a pair of pincers (pedipalps) and the others have altogether 4 pairs of legs. The abdomen is divided into a thick pre-abdomen (mesosoma: lit. "middle-body") with seven segments and a thin articulated post-abdomen or tail (metasoma: lit. "rear-body"). This tail has 5 segments and ends in a knob-like appendix (telson) with a sharp curved sting (aculeus), where the two venom glands have their outlet. The sting is used to kill prey, for defence against aggressors and in some species it also has a role in the courtship display. Ventrally on the first segment of the abdomen there is a small sternal plate. Caudal from the sternal plate is the genital opening which is covered by a small cap (operculum). Behind this, on the third abdominal segment, is a small basal plate on which there are two protuberances which form a typical V-shaped comb (the so-called "pecten"). This is a sensory organ only found in scorpions. Scorpions have a primitive nervous system. There is one pair of median eyes and two to five pairs of lateral eyes. These eyes are simple (ocelli). There are no compound faceted eyes like the large eyes of many insects. There is an open circulation. The blood flows via tissue sinuses. The elongated heart has seven ostia and pumps blood containing haemocyanin (which is a haemoglobin-like oxygen-carrying pigment that contains copper, not iron). The creatures breathe via 4 book lungs which are connected to the outside world via spiracles (respiratory openings) ventrally on the 3rd to 6th abdominal segments. Undigested remains are discharged via the anus. They

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also have a type of kidney (Malpighian tubules) via which excess nitrogen is discharged in the form of guanine. There are excretory coxal glands at the base of the first pair of legs.

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Some scorpion species are long (*Hadogenes troglodytes* XE "*Hadogenes troglodytes: scorpions, taxonomy*" up to 21

cm), others are heavy (

Pandinus

imperator

XE "

Pandinus

imperator: scorpions, taxonomy

"

,

also called the

Emperor scorpion;

Heterometrus

sp.), while others are small (

Microtityus

waeringi

XE "

Microtityus

waeringi: scorpions, taxonomy

" , adult 12 mm). All scorpions are exclusively carnivorous. While they wait for their prey, the tips of the movable fingers of the pedipalps as well as the tips of the comb (chemo- and mechanoreceptors) rest on the ground. A scorpion first grasps its prey (generally insects) with the pedipalps. If the prey is not immediately overpowered, they sting it by bending the tail forwards over the body. The venom is actively injected. The scorpion releases gastrointestinal juices over the prey in order to liquify it and later suck it up. They consume only the body fluids and liquidified tissues of their prey. A meal can last several hours. Some species are cannibalistic.

*

Because many scorpions live in dry environments, they have become adapted to minimise loss of water. This is made possible in part by a watertight cuticle based on chitin. This has unusual optical characteristics. Scorpions fluoresce with a greenish colour under long-wave UV light.

This makes them easy to spot at night with the aid of a UV lamp. The reason for this fluorescence is unclear. Recently moulted scorpions do not fluoresce. The fluorescence is caused by a substance in a thin layer of the cuticle, the so-called hyaline layer. The fluorescent substance might be beta-carboline (tryptophan metabolite), a by-product of the tanning process as the new cuticle hardens. If this layer is preserved in fossils, it also fluoresces. When the animals are preserved in alcohol, after some time the alcohol can also fluoresce.

3 Reproduction

Both spiders and scorpions have distinct sexes, except for a few species which reproduce by parthenogenesis and have no males. In spiders there is often a clear sexual dimorphism (males differ from females), in contrast to scorpions. Thus it is not easy to determine the sex of a scorpion. Immature scorpions all look like females. Adult males tend to have a relatively larger metasoma and pedipalps. Sometimes there is some allometric growth (changed proportions) in the pedipalps of the males, so that they are heavier, longer or thicker than those of the females. The pecten of the male is usually somewhat larger and has more and larger teeth. During the reproductive period a male scorpion deposits a stalked spermatophore on a smooth firm spot on the ground. This is a packet of gelatin that has a very specific form with a droplet of sperm on top. The male grips the female and together they engage in a mating dance ("*pas de deux*"). Some species intertwine their tails during courtship. During this mating dance he leads the female over his packet of sperm, whereby fertilisation occurs. The females do not lay eggs, but instead give birth to live young: small white, developed mini-scorpions, only a few mm in size. Many scorpions are subsocial, meaning that a female carries her young on her back until their first moult (at around one to four weeks). During this period the little ones still feed on the yolk remains in their body. Afterwards the creatures choose to live in isolation. They are active at night. They shun light and hide during the day in anything lying on the ground, under stones or wood, in footwear, clothes or blankets. Some species burrow underground. The animals are sexually mature after 6 months to 3 years, following four to seven moults.

4 Differences from other arthropods

At a first superficial glance, Uropygi, Amblypygi, solifugids or pseudoscorpions can be mistaken for scorpions. Adult scorpions cannot be confused with Schizomyda or with Palpigrada, since these last two animal groups only include small species (3 mm).

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§ Uropygi or whip scorpions. This group of arthropods includes around 85 species. They have chelicerae and pedipalps. The first pair of legs is moderately long. They have a sort of whip-like tail which makes them look somewhat like scorpions. They do not have stings as real scorpions do. From special anal glands they can spray a caustic liquid which consists of a mixture of 84% acetic acid and 16% caprylic acid. Sometimes the venom also includes formic acid. Due to their typical vinegary odour, in English the creatures are sometimes called “vinegarroons”.

§ Amblypygi or tailless scorpions. The first pair of legs is extremely long and resembles a pair of antennae. They have heavy pedipalps, but no sting. They are harmless.

§ Solifugae or Solpugida. These rather large animals are sometimes also called “sun spiders” or “wind spiders”, referring to their diurnal habits and their high speed. They have no sting.

§ Pseudoscorpions are rarely longer than 8 mm, and have neither a long abdomen nor a sting.

5 Taxonomy

5.1 Taxonomy, general

Scorpion, spiders, ticks and mites are all arthropods. They belong to the Chelicerata, which refers to the structure of the front appendages. Various authors have proposed different classification schemes. These are based inter alia on the form of the sternum, the presence of protuberances on the legs, the morphology of the telson and the number of lateral eyes. The number of trichobothria (small hair-like sensory organs) on the femur of the pedipalps is also used. Thus the Buthidae have a triangular central sternal plate. The other families have a pentagonal sternum. In general it can be said that scorpions with massive claws (Scorpionidae, Chactidae, Diplocentridae, Bothriuridae) are relatively harmless, while the more dangerous species (Buthidae, Vaejovidae) have finer claws. An often heard explanation is that species

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with massive claws have no difficulty killing their prey, and so do not need powerful venom. Species with thin delicate pedipalps would need extra assistance from powerful venom. It sounds logical, but it is not known if this correct. The colour of the animal is not significant with regard to toxicity. The identification of a scorpion at the species level is a job for specialists. The use of taxonomic keys presumes a good knowledge of the nomenclature, the jargon, the morphology and anatomy of the animals. Drawings are generally diagrams which require some interpretation, for which prior knowledge is necessary. Several species are indistinguishable from one another on morphological grounds. These cryptic species can only be distinguished with chemical or genetic methods.

5.2 Taxonomy, families

[Bothriuridae](#) [*Buthidae](#) [Caraboctonidae](#) [Chactidae](#) [Chaerilidae](#) [Euscorpiida](#)
[e](#) [*Hemis](#)
[corpiidae](#)

[luridae](#)

[Microcharmidae](#)

Pseudo- chactidae

[*Scorpionidae](#)

[Superstitioniidae](#)

[Vaejovidae](#)

[Akravidae](#)

OF 1500 SPECIES OF SCORPIONS WORLD WILD, ONLY ABOUT 20-25 ARE REGARDS AS DANGEROUS.

5.3 Taxonomy, genera

§ *Androctonus*. Thick-tailed scorpions: *A. australis* XE "*Androctonus australis: scorpions, taxonomy*" is the most important species in the Old World.

§ *Buthus*: in the case of *Buthus occitanus* XE "*Buthus occitanus: scorpions, taxonomy*", the major species within this genus, the venom varies sharply in toxicity depending on the geographical region.

Buthus tamulus

XE "

Buthus tamulus: scorpions, taxonomy

" was renamed

Buthotus tamulus

XE "

Buthotus tamulus: scorpions, taxonomy

"

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§ *Mesobuthus* (earlier placed within the genus *Buthotus*): *Mesobuthus tamulus* XE "*Mesobuthus tamulus: scorpions, taxonomy*"

" or "Red Indian Scorpion" primarily causes cardiovascular problems (hypertension, arrhythmia, pulmonary oedema).

§ *Hottentotta* and *H. minox* XE "*Hottentotta minox: scorpions, taxonomy*" are often found under the bark of

Acacia

trees. The sting is painful.

§ *Leiurus*: *Leiurus quinquestriatus* XE "*Leiurus quinquestriatus: scorpions, taxonomy*" is one of the most frequently encountered scorpions in the Sahel. Although the animal produces relatively little venom, the venom is quite powerful.

§ *Compsobuthus* and *Odonthobuthus*: *C. acuticarinatus* XE "*Compsobuthus acuticarinatus: scorpions, taxonomy*" from Egypt

and

O.

doriae

XE "

Odonthobuthus doriae: scorpions, taxonomy

"

from Iran are moderately venomous.

§ *Parabuthus*: Most species are found in South Africa and Namibia. The animals measure 5-14 cm and are brown-yellow to black. The genus is distinguished from others through stridulatory granules on the dorsal side of the first two tail segments. They can make a noise by rubbing their sting over these small knobs. They are very venomous. Local pain and systemic effects and even death can be the result.

P. liosoma XE "*Parabuthus liosoma*:

scorpions, taxonomy

" , *P.*

granulatus

XE "

Parabuthus granulatus: scorpions, taxonomy

"

, *P. transvaalicus*

XE "

Parabuthus transvaalicus: scorpions, taxonomy

"

, *P. pallidus*

XE "

Parabuthus pallidus: scorpions, taxonomy

" and

P. fulvipes

XE "

Parabuthus fulvipes: scorpions, taxonomy

"

are the most notorious species.

Parabuthus

species are unique in that they can also spray venom in a fine jet. This probably involves a reflex which is triggered when the animal feels threatened. The animal does not aim the jet in a specific direction, but can spray up to 1 metre away and 50 cm high.

§ *Centruroides*: This genus includes the most important scorpions in the New World. *Centruroides suffusus*

XE "

Centruroides suffusus: scorpions, taxonomy

" and

C. sculpturatus

XE "

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Centruroides sculpturatus: scorpions, taxonomy

" (=

C. exilicauda

XE "

Centruroides exilicauda: scorpions, taxonomy

") are notorious.

C. suffusus

XE "

Centruroides suffusus: scorpions, taxonomy

" measures up to 9 cm, is yellow to brown in colour and has two longitudinal stripes on the tergites of the pre-abdomen.

§ *Tityus*: This genus includes more than 100 species, including *T. serrulatus* XE "*Tityus serrulatus: scorpions, taxonomy*

"

(Brazil). This creature is parthenogenetic. It is fairly common in urban environments and - like *T. bahiensis*

XE "

Tityus bahiensis: scorpions, taxonomy

" - enters houses.

T. trinitatis

XE "

Tityus trinitatis: scorpions, taxonomy

"

is highly venomous and is found in sugar cane fields and cocoa plantations. However, this species is not found in houses.

6 Distribution

Virtually all lethal species belong to the Buthidae family. These animals are found primarily but not exclusively in dry areas. Not all species are found everywhere. Thus, *Androctonus* is a problem in many Maghreb countries, while

Leiurus

primarily poses problems in the Middle East. In South Africa, species belonging to the genus

Parabuthus

regularly cause difficulties. In Mexico

Centruroides

sp. are feared, while in South America

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Tityus

species are notorious. In the Buthidae family, the medically important and dangerous genera have the following distribution:

Androctonus

from Morocco and Senegal eastwards to India

Buthus

Mediterranean, Middle East and East Africa

Hottentotta

Northern Africa and the Middle East

Leiurus

East Africa and the Middle East

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Parabuthus

from Sudan to South Africa

Mesobuthus

India, Southern and Central Asia

Tityus

South America

Centruroides

USA, Mexico, Central America

The most important species are

§ *Buthotus tamulus* XE "*Buthotus tamulus: scorpions, distribution*"

§ *Leiurus quinquestriatus* XE "*Leiurus quinquestriatus: scorpions, distribution*"

§ *Androctonus crassicauda* XE "*Androctonus crassicauda: scorpions, distribution*" (and *A. australis*)

"
Androctonus australis: scorpions, distribution
"
)

XE
An

§ *Tityus serrulatus* XE "*Tityus serrulatus: scorpions, distribution*"

§ *Centruroides suffusus* XE "*Centruroides suffusus: scorpions, distribution*"

7 Scorpion venom

Scorpion venom is a mixture of various active substances, but generally the neurotoxins are the most important. The venom of *C. sculpturatus* contains a peptide neurotoxin that opens Na⁺

-channels (

b

-toxin). Sodium is primarily an extracellular ion, and is necessary inter alia for maintaining an electrical voltage difference across the cell membrane. When the channels open, sodium flows into the cell and depolarises the membrane. The venom causes depolarisation, the action potentials grow longer and the nerves fire non-stop. Other components in the venom inhibit the deactivation of Na⁺

+

-channels (

a

-toxins) and thus have a similar clinical effect. However, little of the venom can penetrate the blood-brain barrier. Apparently there are components which have an effect on the central nervous system, with bulbar impairment, but these have not yet been adequately described. There follows a massive release of neurotransmitters, both acetylcholine and noradrenaline

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from nerve endings and adrenaline from the adrenal medulla. The main part is formed by the catecholamines. Another component in the venom (charybdotoxine) blocks K

+

-channels. This molecule is very similar to the venom of

Conus

shells. The venom of

Leiurus

sp. includes chlorotoxin, which specifically acts on Cl

-

-channels. Chlorotoxin binds specifically to receptors on cerebral glioma cells and is being studied in experimental braincancer therapy. [

Primary brain tumors (gliomas) have the unusual ability to diffusely infiltrate the normal brain thereby

evading surgical treatment. Chlorotoxin is a scorpion

toxin that specifically binds to the surface of glioma cells and impairs their ability to invade.

] Scorpion venom also contains serotonin, which contributes to local pain. Serotonin might be responsible for triggering uterine contractions and causing miscarriages in women who are in an early stage of pregnancy when they are stung. The venom of

Tityus

sp. includes a kallikrein inhibitor. The venom of most scorpion species has not yet been

studied. Scorpions can be electrically "milked" to obtain venom. The extent to which the

composition of venom obtained in this way differs from the natural product is a subject of

research.

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Note: Scorpion venom and ion channels in nerves

On a neuron's cell membrane there are various forces at work which, at rest, are in dynamic equilibrium. At rest the cytoplasmatic side is negatively charged vis-à-vis the outside. There is an electrical gradient of 70 mV which attempts to move ions from an area with high charge density to an area of low charge density.

*

Several ions show a concentration gradient. The concentrations of Na⁺ and K⁺ ions on the opposite sides of the membrane differ widely. There is a high potassium concentration inside the cell, while outside the cell this concentration is low. The opposite is true for the sodium concentrations. There is thus both an electrical and a chemical gradient. There is a sodium-potassium pump in the nerve membrane. For every three sodium ions that are pumped out, two potassium ions are brought into the cell. Many potassium ions leak out of the cell, which further increases the negative charge of the interior of the membrane. The nerve cells also have various ion channels, including sodium channels which are opened when there is a specific electrical voltage (voltage-gated channels). It is these channels which are permanently opened by scorpion venom.

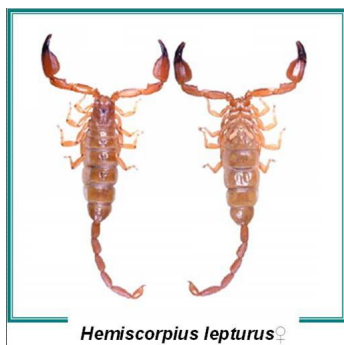
8 Clinic

8.1 Clinic, general

Most scorpion venoms contain little or no cytotoxic enzymes, so that a sting produces little local tissue damage. An exception to this is the cytotoxic venom of *Hemiscorpius lepturus* XE "*Hemiscorpius*

lepturus: scorpions, taxonomy

", a scorpion from Iran. There are four factors which play a role in defining eventual symptoms: the quantity of venom introduced and its toxicity as well as the size and medical condition of the victim. Many scorpions without medical interest have venom that can kill a mouse, but when introduced into human beings only produces symptoms analogous to those of a bee sting. If there is an allergy to this venom, however, anaphylaxis can follow and death can result from a sting of even a "harmless" scorpion.



8.2 Clinic, local effects

Rapidly developing pain at the site of the sting is characteristic. Swelling and local redness are often limited but can be quite serious, primarily with *Hadrurus hirsutus* XE "*Hadrurus hirsutus*:

scorpions, taxonomy

" (southwest USA),

Buthus occitanus

(northern Africa) and

Isometres maculatus

XE "

Isometres maculatus: scorpions, taxonomy

" (Australia). Local necrosis is exceptional. Local paraesthesias can occur. Several South African scorpions can squirt venom up to one metre away. If this comes into contact with the cornea, a chemical keratitis with burning pain develops.

8.3 Clinic, systemic effects

These can either develop quickly, within ten minutes, or - more rarely - slowly, after only 24 hours. More and more, doctors use a clinical gradation:

§ degree 1 (local pain and paraesthesias)

§ degree 2 (idem plus pain and/or paraesthesias in a place other than the site of the sting)

§ degree 3 (cranial nerve impairment such as diplopia, blurred vision, dysarthria or neuromuscular dysfunction such as muscle cramps and involuntary movements)

§ degree 4 with both cranial nerve impairment and generalised neuromuscular dysfunction.

*

Evolution from degree 1 to degree 4 can occur very quickly (sometimes within a half hour). Generalised fatigue with muscle stiffness and weakness, anxiety and restlessness are frequent. The tendon reflexes are hyperactive. Sometimes fasciculations, tremors and/or clonus develop. Convulsions are not unusual after *Leiurus*, *Androctonus* and *Mesobuthus* stings. The relaxation phase of the Achilles tendon reflex can be slowed. If the patient is able to stand, his or her gait will often be atactic.

Tityus serrulatus

often causes muscle weakness which can persist for a very long time. Tachypnoea and dyspnoea can be followed by respiratory arrest. There is a high risk of this complication following

Centruroides

stings

. *Centruroides sculpturatus*

(southern USA) is predominantly neurotoxic, and cardiovascular complications are generally absent. The effects of the venom on the central nervous system have not been adequately described. More often than not, they are minimal. Symptoms of orthosympathetic and parasympathetic stimulation can develop with agitation, hypersalivation, sweating, hyperthermia, nausea, vomiting and diarrhoea, and sometimes priapism. Miosis, mydriasis and anisocoria can occur. Sometimes mydriasis and bradycardia or extreme tachycardia develop. The patient can experience hypertension, cardiac arrhythmia (with or without heart failure) and pulmonary oedema. These symptoms are the result of a massive release of endogenous catecholamines from the sympathetic nervous system and the adrenal glands. Cardiovascular toxicity is pronounced in

Leiurus quinquestriatus

and

Buthotus tamulus

stings. Acute oedematous and/or haemorrhagic pancreatitis, rhabdomyolysis and diffuse intravascular coagulation can occur. Children are generally very restless, with crying and shouting, agitation, shaking, twisting and swinging of their limbs. The child cannot still sit. Mortality depends largely on age. Children, the elderly and people with a serious pre-existing medical condition have a substantially higher risk of death than adults.

9 Scorpion stings

9.1 Scorpion stings, diagnosis

The diagnosis is essentially clinical. Due to the quick and intense local pain, the scorpion is

often noticed. Yet the typical victim is someone who is usually stung at night in the foot, outdoors, possibly when he/she has moved a stone or some wood. People are also stung in the morning when they try to put on a shoe in which a scorpion is hiding. Occasionally in North Africa men are stung in the genitalia when they urinate against an object while squatting. The laboratory often shows leukocytosis, hyperglycaemia and a transient increase of the pancreatic and cardiac enzymes. The ECG can display temporary ischaemic deviations.

9.2 Scorpion stings, differential diagnosis

§ Spider bite by *Latrodectus mactans* (black widow). The bite of the female spider produces little local reaction, contrary to bites by *Loxosceles reclusa*, yet is characterised by marked abdominal muscle rigidity, pain and excessive sweating. Dysphagia, sialorrhoea, vision impairment and generalised hyperaesthesia are generally absent with these spider bites. In South America, bites by *Phoneutria* spiders need to be considered.

§ Overdoses of neuroleptics, anticholinergics or tricyclic antidepressants. Generally these products do not produce excessive salivation and there is no local pain.

§ Organophosphate poisoning. These insecticides also cause agitation, restlessness, muscle weakness, muscle fasciculations, tachycardia and respiratory difficulties. However there is no pain.

§ Tetanus, botulism, diphtheria, meningitis and encephalitis can cause similar symptoms.

§ Neurotoxic snakebite.

§ Thyroid storm, carcinoid or pheochromocytoma.

9.3 Scorpion stings, treatment

Patients with systemic symptoms (grades 3 and 4) must be hospitalised for 24-48 hours, preferably in an intensive care unit. Cardiac arrhythmia, hypertension and respiratory problems must be monitored. The airways must be kept open. Administration of oxygen and artificial respiration can be necessary.

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Pain relief with a powerful analgesic is often required. Local application of ice can reduce the pain, but may not be tolerated due to hyperaesthesia of the skin. Opiates should be avoided because of the danger of respiratory depression. Sometimes simple infiltration of the sting site with 2% xylocaine (i.e. lidocaine without adrenalin) can reduce the pain. Intravenous administration of 10 ml of a 10% solution of calcium gluconate over 10-20 minutes can decrease muscle pain and cramps for a short time (30').

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The general management is aimed at neutralising the effects of the overstimulation of the autonomous nervous system. Steroids and antihistamines are not routinely required. Hypertension is counteracted by giving nifedipine XE "Nifedipine: scorpions stings, treatment" (calcium-antagonist, Adalat®) or prazosin XE "Prazosin: scorpions stings, treatment" (alpha-blocker, Minipress®). In case of cardiac arrhythmia, xylocaine (lidocaine) may be given IV. Atropine is sometimes used as a parasympatholytic agent, but can aggravate orthosympathic symptoms. It is not systematically recommended. In case of convulsions diazepam IV should be given. Inotropic drugs and diuretics (furosemide) are indicated if there is heart failure. Hyperthermia requires cooling and salicylates.

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Most cases improve without antiserum within 9-30 hours (except for pain and paraesthesias). In the event of severe envenomation, death frequently occurs within 6 hours after the sting. The therapeutic role of antiserum is somewhat controversial. There are clear geographical differences in effectiveness. With degree 3 or 4 symptoms, IV antiserum is recommended. It should be diluted and administered in an IV infusion over 20-30 minutes. The dose is not age-dependent (e.g. 4-6 ml for *Leiurus quinquestriatus*). Some types of antiserum are also active against other scorpion species. The antiserum against *L. quinquestriatus* will also improve the symptoms of *Androctonus crassicauda* stings. However, this does not apply for all situations

Antisera are good for neutralising neuromuscular effects but have little effect on pain or paraesthesias. A type III hypersensitivity reaction can develop after administering the antiserum (horse, donkey or goat serum) (see treatment of snakebites). Type I reaction (anaphylaxis) is exceptional. Steroids, antihistamines and adrenaline must be on hand. If signs of acute hypersensitivity develop, the infusion must be stopped immediately. The effect of the antiserum is generally noticeable rather quickly. One hour's observation must be allowed before deciding whether to administer a second ampoule. Tetanus vaccination must be checked. Currently F(ab')

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-based antisera are being developed against several species of *Centruroides*

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Antitoxin:

USA and Mexico

Anti-Centruroides

South America

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anti

-*Tityus*

South Africa

Anti-Parabuthus

Maghreb

Anti-Androctonus

and anti-

Egypt and Israel

anti

-*Leiurus*

India

anti-

Mesobuthus

10 Prevention

Firstly, one must reduce the places of shelter and the food supply of the scorpions. Insecticides are only effective in the sense that they eliminate the prey of scorpions. There is often insufficient contact between the body of the scorpion and the insecticides to be directly toxic. Natural enemies of the scorpions include cats and solfugids. Of course, a house cat is no guarantee that there will be no scorpions in or around a house. It is recommended to clear away junk, loose wood etc. (fewer hiding places). The same applies for certain types of vegetation (e.g. *Opuntia* cactus hedges in northern Africa). Cracks and crevices in and around the house must be sealed. In endemic areas it is best to always shake out shoes before putting them on, and to examine clothes and blankets before using them. It is prudent to also check the toilet before use.