Tarantula husbandry and critical care

Tarantulas are gaining popularity as pets, and are seen more frequently in practice. Disease recognition and prevention is essential amongst collections. Clinical examination of spiders and common conditions are discussed in the article.

10.12968/coan.2015.20.2.???

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Key words: Tarantulas | Husbandry | Handling | Diagnostics | Disease

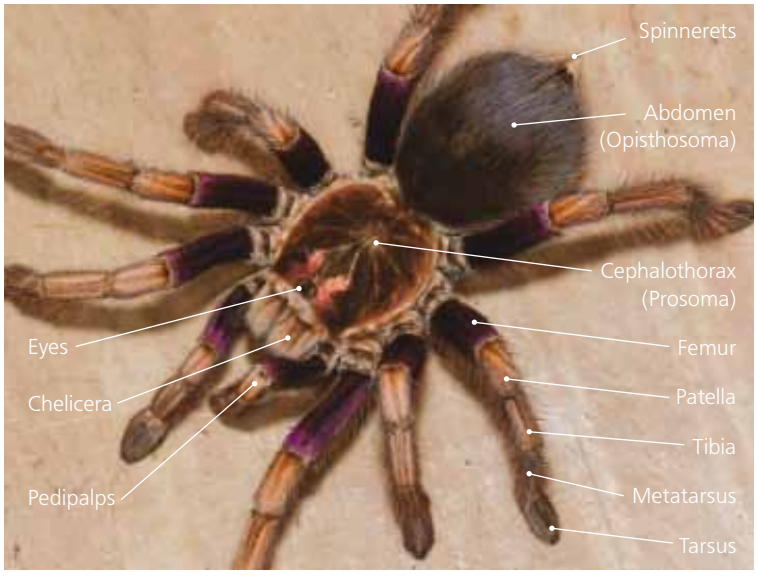

Figure 1: External anatomy of an Ecuador Purple Femur Tarantula (dorsal view) (Courtesy of Andrew Mitchell)

Spiders of the family Theraphosidae, also known as tarantulas or bird-eating spiders, represent an important group of commonly kept arachnids in captivity. There are approximately 900 species within this family. They are becoming increasingly popular within the pet trade and as displays at zoological collections. These animals can be long-lived with a life expectancy of more than 30 years for females in some species; this means that some keepers become emotionally attached to their pets and there is a demand for vets to be willing to treat them. Most males live for approximately 3-4 years and commonly die a few months after their terminal instar once they moult to maturity; there is more demand for female spiders due to their greater longevity. Some males do live longer, and can take 6-7 years to mature. In captivity, male terminal instars can survive up to eight months or more, and rarely can survive up to 18 months. Very occasionally a male tarantula will have a post-terminal moult but will lose their ability to reproduce.

These spiders are arthropods belonging to the Order Araneae, Suborder Mygalomorphae and Family Theraphosidae. Some of the commonly kept species include the Mexican red knee tarantula, (*Brachypelma smithi*), popular because of its bright colouration; the Chilean rose, (*Grammostola rosea*), favoured due to its appearance and because it is a slow-growing, hardy species; and the pink-toed tarantula, (*Avicularia avicularia*) which is reported to be a docile species. The goliath bird eater, (*Theraphosa blondi*), is the largest of the Theraphosids, is fairly fast growing and can reach a weight of 115g and a leg span of over 250mm. This species is sought after by more experienced enthusiasts. The tarantulas mentioned above are terrestrial species, with the exception of the pink-toed which is an arboreal species from South America.

Anatomy

The basic external anatomy is shown in Figure 1.

Theraphosids have two pairs of book lungs located on the ventral aspect of the abdomen. Most other spiders have a pair of tracheae and one pair of abdominal book lungs although there are other combinations found within this order (Ruppert et al, 2004). Spiders have a large heart located in the dorsal abdominal segment, and an open circulatory system. Blood vessels do transport the blood to a specific place but thereafter the blood flows freely in the open spaces between the organs. The colourless blood is called haemolymph. They have two main nerve centres

Figure 2: Tibial spur on an adult male. (Courtesy of Romain Pizzi ©Zoological Medicine Ltd)

located in the cephalothorax and have very good tactile reception, chemoreception and vision.

Adult males of many species have hooked tibial spurs on the first pair of legs (Figure 2). These are used during mating to secure the female's fangs. Mature males also possess emboli on their pedipalps which resemble boxing gloves. Microscopic examination of a moult, looking for spermathecae in the epygial region (ventral surface of the opisthosoma, between the first pair of book lungs), will help to determine the sex of the tarantula.

Husbandry

Enclosure size is species dependant and all dimensions must be taken into consideration. A fall from a height of even 30cm can lead to fatal opisthosoma trauma. Heavier spiders such as the goliath bird eater will be more susceptible therefore tanks under 30cm high are recommended. Terrestrial tarantulas have hooks on their feet so mesh top tanks are discouraged; if claws become trapped in the mesh limb autotomy may occur. Pink-toed tarantulas will require higher enclosures as they are an arboreal species.

Tarantulas are photophobic and do not require additional lighting. Recommended temperature ranges for most species of tarantula is within 20-30°C and a maximum-minimum thermometer is advised for close monitoring of environmental temperatures. If additional heat is needed, a heat mat under thermostatic control can be placed on the outside of part of the enclosure, always on a side, never underneath.

Tarantulas should not be directly sprayed with a light mist of water as this can cause irritation and stress. Instead, the substrate should be moistened for those species requiring a higher humidity, such as the Goliath birdeater and pink-toed tarantula. Water should always be available, provided in a shallow dish.

Invertebrates such as crickets and locusts should be the spider's main diet; these should be fed, not starved, to ensure optimum nutritional content. Wax worms should be fed sparingly due to their high fat content and poor nutritional value. Some larger species may accept whole killed vertebrates such as mice. In contrast to other animals, tarantulas do not need calcium supplementation; spiders do not incorporate calcium carbonate into their exoskeletons (Pizzi, 2010).

Figure 3: Handling session.

Physical Examination – General Handling

In general, arachnids are not recommended for handling due to the risk of damage to the animal and also public risk of envenomation from a bite and sensitivity from urticating hairs. However, some clients or institutions may provide handling sessions such as 'arachnophobia sessions' and may seek veterinary advice (Figure 3). These encounters can be beneficial to change people's perception of spiders. In these sessions gloves are not normally worn by trained personnel as gloves may re-enforce the public's impression that spiders are harmful, giving them a negative image and eliciting a fear response towards the animals. New World species are generally used for these sessions (*Brachypelma* spp. and *Grammostola* spp. being the most used genera) due to their general docility, although there are occasional exceptions to this. Old World species tend to be more aggressive and are more likely to bite.

Nicotine was once used as an insecticide and is harmful to all invertebrates, therefore smokers must always wash their

Figure 4a: Gently restrain the spider by putting pressure on the centre of the cephalothorax. (Courtesy of Romain Pizzi ©Zoological Medicine Ltd) and Figure 4b: The spider then can be picked up securely.

hands prior to handling these animals. Tarantulas can bite and can cause severe irritation from urticarial hairs. These hairs are either flicked directly by a stressed spider from the opisthosoma or are left as residues within the spider's environment. Some people are extremely sensitive to these hairs and can develop severe erythematous reactions. If inhaled or if hairs get into the eye then reactions can become more serious. Gloves are recommended when handling these animals in the clinic. Aerial hairs can be avoided by keeping the spider away from people's faces, a distance of one metre being recommended. Goggles can also be worn as a safety precaution.

If the spider has to be handled for a training session or for a clinical examination then either of two methods may be applied.

Figure 5: Ultrasonography of a theraphosid. (Courtesy of Romain Pizzi ©Zoological Medicine Ltd)

If the animal appears docile then it can be allowed to walk onto the hand. The second method is to pick up the spider directly either by cupped hands or in the case of an examination by placing the index finger or a pencil gently on the centre of the rigid cephalothorax (Figure 4a). The middle finger and thumb are then placed between the second and third pair of legs either side of the cephalothorax (Figure 4b). When held for an examination the spider can be held with its body upside down. This seems to put them in a torpor-like state. These animals should always be handled over a table as a fall as little as 30cm may be fatal.

Spiders must not be handled during a moult including the pre- to post-moult period. Feeding should have resumed before they are handled again. The duration of this moulting process can be up to a month. Adult theraphosids usually moult once a year and owners should be encouraged to record this so that moulting times can be predicted.

Diagnostic Approach

If the spider is kept in a small enclosure then it is beneficial for the owner to bring the whole set up into the surgery. A detailed history, emphasising the husbandry aspect, is essential as the majority of problems seen are related to inadequate husbandry. Owners usually notice a change in behaviour with their animal such as reluctance to move, remaining in an abnormally huddled posture and anorexia. History should also include whether the spider was wild caught or bred in captivity as this is important when considering parasitic diseases. Further details such as when the tarantula last ate and last moulted should also be obtained.

The spider can be examined by viewing it from all sides in a clear-walled container. More docile species can be examined by careful handling. Gloves should always be worn for this. Check the whole body surface looking for signs of disease, masses, ectoparasites, wounds, fungal infections (which are usually visualised at the opening of the book lungs) and dehydration.

Imaging is rarely used in spiders although a couple of publications have been produced. Radiography is of limited value

due to the exoskeleton consisting of proteins and very little soft tissue differentiation being evident. Ultrasonography (Figure 5) is of value to detect the presence of large endoparasitic acrocerid larvae in the opisthosoma (Johnson-Delaney, 2006).

Endoscopy is beneficial, providing magnification when examining oral discharges in tarantulas. This can aid in differentiation of a bacterial infection from panagrolamid nematodes as these nematodes can be seen easily with an endoscope due to magnification effects.

Bacterial and fungal culture and sensitivity can be performed on oral or anal discharges or from lesions. Interpretation of results must be taken with caution as some pathogens are often difficult to culture using the standard technique. Postmortem sampling is often unrewarding due to rapid gut breakdown and translocation of bacteria after death. Necropsy examination should be performed immediately after death or euthanasia.

Cytology (stained and unstained) can provide useful information for identifying bacterial, fungal and protozoal infections. Postmortem examination and histology can be used to visualise melanised inflammatory nodules, which are a typical inflammatory response by arthropods due to trauma and infection. Faecal analysis may be useful to identify protozoans and gregarines.

Blood (haemolymph) smears can be performed but interpretation is still in its infancy, with differences in opinion on nomenclature of cell types. Haemolymph can be sampled using a 30 gauge insulin needle and syringe, collecting from the dorsal midline of the opisthosoma. After sampling, place a small amount of tissue adhesive onto the cuticle to prevent haemorrhage. An alternative method for sampling is by inserting the needle into the ventral area of the joint membrane of a limb.

Common conditions

Alopecia

Excessive stimuli may cause the spider to kick off irritating (urticating) hairs. Hair loss can be seen on the dorsal and caudal aspect of the opisthosoma of many New World terrestrial tarantulas. In captivity this often indicates environmental stress. The hairs will not regrow but will be replaced after the moult. Treatment is not required but husbandry issues leading to hair loss must be addressed. Old World (Asian and African) tarantula species do not have urticating hairs and therefore do not develop alopecia, nor do most arboreal species.

Dysecdysis

Tarantulas in dorsal recumbency are normally undergoing ecdysis (normal moulting) and are very susceptible to trauma (Figure 6). Some owners will call for advice, concerned that the spider has died. Dead spiders are normally found in an upright position with the legs flexed beneath them; the legs only have flexor muscles and so limb extension is dependent on haemolymph pressure. Dysecdysis (abnormal or difficulty moulting) is a common presentation in tarantulas and optimum husbandry with the provision of good nutrition and hydration is important in order to minimise this. Assisting with the removal of the old cuticle must be avoided as pulling this will result in tearing of the new fragile cuticle underneath. The new cuticle is initially soft to enable body

Figure 6: A tarantula in dorsal recumbency undergoing a moult. (Reproduced with permission from the BSAVA Manual of Exotic Pets, 5th edition. Courtesy of Romain Pizzi ©Zoological Medicine Ltd)

expansion and then will harden over a few hours to a few days. If limbs are trapped in the old cuticle it is better to wait until the new cuticle has hardened. Attempts then can be made to gently remove old cuticle using surfactants such as household detergent and water, taking care to avoid the book lungs which are situated on the ventral surface of the abdomen. Old cuticle can also be removed with fine scissors but in extreme cases autotomy of affected limbs may be an option, followed by the application of tissue glue adhesive at the site to prevent leakage of haemolymph. Autotomy can be induced by grasping the femur segment of the limb (see Figure 1). Autotomy is usually performed by pulling the femur rapidly upwards, although the spider may shed the limb itself while the leg is being held. Regeneration of the limb will take place and it will return to normal size within the following two to three moults (Pizzi, 2010).

Trauma

Physical trauma and loss of haemolymph is serious in Theraphosids. If a fall does occur then immediate first aid is essential. If the wound is not too big then it can be dried using pure talcum powder (with no added perfume or other additive), or it can be sealed with tissue glue. Limbs can be injured easily, for example, terrestrial Theraphosids have fine hairs on their feet and these can catch on clothing fibres. This may result in autotomy or damage to the limb with loss of haemolymph from the joints. If this occurs, the limb should be removed at the joint. It is advisable to keep the tarantula on a paper towel substrate afterwards for 24-48 hours to monitor for any continued leakage of haemolymph. This should be visible on paper towel but would be missed on normal substrate as it is pale. Theraphosids may need to be treated for dehydration dependent on the volume of haemolymph lost.

Figure 7: Administering fluids to a tarantula.

Figure 8: Small volumes of fluids can be administered into a leg

Endoparasites

Wild caught individuals may harbour acrocerid (spider-fly) larvae. Antemortem, this can be confirmed by ultrasonography. There is no treatment available and this disease is seen in wild caught specimens. Larvae are deposited on the spider's body, crawl to the book lungs and penetrate the opisthosoma between the lamellae. Larvae may be present for months to even years. The mature fourth instar is the destructive feeding stage, consuming tissues and bursting out of the dorsal opisthosoma to pupate.

Mermithid nematodes are also seen in wild caught individuals, who may be asymptomatic for months to years. Clinical signs include an enlarged asymmetrical opisthosoma, malformation of palps and shorter legs. Absence or poor development of male secondary sexual characteristics is also seen. Treatment is not available.

Oral nematodes of tarantulas

Panagrolamid nematodes observed within the mouthparts of some tarantula species are an important disease of captive spiders seen in both captive bred and wild caught specimens. The exact lifestyle of these parasites is unknown at the time of writing, however this appears a condition solely of captivity. It could have zoonotic potential as some related nematodes such as *Halicephalobus* and *Haycocknema* spp. have proven to be zoonotic. The spider presents initially with lethargy, anorexia and a change in posture. White discharge can also be seen between the mouth and chelicerae during the later stages of infection.

All new spiders should be quarantined for a minimum of 30 days. Any anorexic spiders should have their quarantine duration increased. Examine the areas between the mouth and chelicerae carefully before any spider leaves quarantine. In collections with particularly rare or valuable specimens, flush the mouth with physiological saline under a brief general anaesthetic. The contents are examined under magnificaton; a mass of nematodes 0.5-3mm in length will be seen in infected individuals. Alternatively, examination by endoscopy will improve visualisation of these nematodes, due to magnification. The nematodes have a symbiotic relationship with bacteria which cause tissue necrosis.

Despite various treatment options trialled in the literature, with a variety of medications such as ivermectin, fenbendazole, oxfendazole, enrofloxacin and trimethoprim sulphonamides, death has always occurred with this infection. Until the exact lifecycle of this nematode is known, it is advisable to still consider this as having zoonotic potential; human cases have occurred following bites from infected spiders, resulting in infections of deep wounds. Larger spiders such as *Theraphosa blondi* have the potential to bite in excess of 1cm due to the large fangs. Due to this risk, unsuccessful treatment options and the concern for spread in a collection, euthanasia of an affected spider is still recommended. The mode of transmission between spiders is unknown, but spread between infected containers, and vector transmission from Phoridae flies and mealworm beetles (*Tenebrio molitor*) have been speculated.

Poisoning

Care must be taken if other animals in the household are being treated with commercial flea and tick products. Clinical signs include anorexia, incoordination, twitching and death. Reports of death in tarantulas due to the residual effects of fipronil have been published. Gloves should always be worn when handling these animals and care must be taken in the surgery when using clear containers to examine or house individuals. If fipronil has been used recently, such as in snakes with snake mites, then this may adversely affect the tarantula. Treated enclosures have been known to kill spiders despite being washed (Pizzi, 2010).

Supportive Care

Correcting the underlying environmental problems, addressing temperature and humidity is essential in stabilising these animals.

Rehydration in tarantulas can be achieved by placing the cephalothorax of the spider in a shallow dish of water, taking care not to submerge the book lungs on the ventral surface of the opisthosoma. Most spiders will hydrate within a few hours.

Severely dehydrated spiders are unable to move as extension of limbs is dependent on haemolymph pressure. Fluid therapy

can be achieved by administering intrahaemolymph injections with isotonic fluids, using a 30 gauge insulin needle and syringe. Fluids are administered directly into the heart in the dorsal midline of the opisthosoma (Figure 7). If the heart is missed then fluids will still be effective as tarantulas have an open venous and closed arterial system. After injecting, seal the cuticle with tissue adhesive to prevent iatrogenic haemorrhage. A safer method to avoid haemorrhage it to administer fluids into a limb by inserting the needle in the ventral area of the joint membrane (Figure 8). The disadvantage of this method is that fluid administration is slow and only small fluid volumes can be given (less than 0.1ml).

Anaesthesia

Several key obstacles limit successful anaesthetic and analgesic use in invertebrates. These include subjectivity in pain assessment; inadequate knowledge of anaesthetic and analgesic efficacy, safety, dosages and dosing frequency across species; the inability to monitor anaesthetic depth; pharmacokinetics of anaesthetic and analgesic drugs and the unknown relationship between risks and benefits for specific drugs (Sladky, 2014).

Anaesthesia may be necessary to allow physical examination, to allow for diagnostic sampling, and to allow for treatment such as exoskeleton repair or manual removal of ectoparasites.

Gaseous anaesthetics are the method of choice for anaesthetising tarantulas. Isoflurane and sevoflurane are both effective and commonly used anaesthetic gases in the clinical setting. Induction can be slow, taking as long as 20 minutes before there is a loss of righting reflex. Carbon dioxide has also been used by entomologists for anaesthesia, although this option is controversial and it is not an anesthetic agent. (Sladky, 2014).

The animal can be placed under a large mammalian facemask or in an induction chamber, and gas is then passed over the body (Figure 9a). Most terrestrial invertebrates use a tracheal system for respiration and can readily absorb volatile anaesthetic gases. Gas enters the trachea through the spiracles and travels through the tracheoles to the fluid-filled tips where gas and oxygen diffuses directly from tracheoles into the cells and carbon dioxide diffuses from the cells into the tracheoles. It is also important to understand that respiratory openings of most arthropods are not found on the head but on the body at various locations. Masks over the head of tarantulas will not be effective to maintain anaesthesia and delivery of gas needs to be directed to the respiratory openings. In tarantulas the abdomen needs to be contained within the mask as the book lungs are located on the ventral abdomen (Figure 9b).

Another method of anaesthetising the animal is to place the invertebrate in a closed container with a cotton ball saturated with isoflurane or sevoflurane liquid. Care must be taken not to allow the spider to come into direct contact with the saturated cotton wool ball. The primary concern with either of these methods is the risk of environmental gas exposure of personnel.

Monitoring anaesthetic depth can be a bit of a challenge: there is a lack of available methods other than the loss of the righting reflex, and a reaction or otherwise to noxious stimuli such as a

Figure 9a: Induction and 9b maintenance of anaesthesia in Theraphosids. (Courtesy of Romain Pizzi ©Zoological Medicine Ltd)

KEY POINTS

- Tarantulas are becoming more popular and there is a need to recognise species, understand basic husbandry requirements and recognise common conditions.
- A fall from even a short distance can result in opisthosoma trauma and a fatal haemorrhage.
- Care must be taken as tarantulas can bite. Sensitivity from urticating hairs can also occur.
- A thorough clinical history and observation of the animal will aid in diagnosis.
- Common conditions observed in these animals include alopecia, dysecdysis and trauma.

hypodermic needle stick. Many invertebrates experience asystole when anaesthetised but recover without incident. Methods for detection of heart movement have been described but are not clinically feasible in most cases. It is best to keep the anaesthetic level as low as possible, while achieving and maintaining immobilisation. Recovery may require exposing the animal to oxygen in a mask or chamber.

It is unknown whether invertebrates experience pain or are merely capable of demonstrating a reflexive response to a noxious stimulus (Murray, 2012). More importantly, we need to be able to recognise apparent signs of pain in invertebrates even though it is unknown whether the perception of pain is equivalent to that of a mammal, bird or reptile. Many would argue that invertebrates do not have the same anatomic or physiological capabilities to process pain. Little is known about analgesia in invertebrates but many species, especially the cephalopods have well developed nervous systems and some species respond to opioids in a similar manner to mammals. Evidence in support of invertebrates experiencing pain is inconclusive but interesting nonetheless. It has been shown that tarantulas react to painful thermal stimuli in a manner similar to mammals, birds and reptiles. In addition, needle insertion into the exoskeleton incites an immediate withdrawal reaction followed by limb rubbing at the site of needle insertion. Administration of opioids have shown to affect responses to noxious stimuli in tarantulas but dosages required are relatively high (Sladky, 2014). Appropriate anaesthesia should therefore be used to prevent any response to noxious stimuli. Hypothermia is not considered a humane method of anaesthesia as there is no loss of sensation.

Euthanasia

Euthanasia is advised if an animal would otherwise suffer if kept alive. Invertebrates are not governed by the same legislation and standards as vertebrate species and are often not given the same ethical consideration. Adequate analgesia and anaesthesia must be provided prior to euthanasia. Hobbyists sometimes use hypothermia (freezing) as a method of euthanasia. This is considered inhumane; it does not possess analgesic properties and therefore should not be used as the sole method of euthanasia (Cooper and Knowler, 1991). An inhalant agent such as sevoflurane or isoflurane with oxygen supplementation as described above is used; once the spider is anaesthetised, pentobarbitone can be injected into the haemocoel, (Dombrowski and De Voe, 2007). Death can be confirmed with a Doppler probe demonstarting permanent cessation of circulation and heart rate.

Bennie and colleagues (2012) have recently published a paper describing a safe and effective method for euthanasia in terrestrial invertebrates. Euthanasia is achieved, after immobilisation, through the use of an injection of potassium chloride (KCl) causing death through terminal depolarisation of the thoracic ganglia as a result of hyperkalosis. For euthanasia of theraphosid spiders either a dose of 0.5% v/w 300mg/ml KCl can be administered centrally via the sternum into the prosoma ganglia or 1% v/w 300mg/ml KCl can be delivered via intracardiac delivery. This method is effective in ablating the nervous system and is non-recoveral (Bennie et al, 2012). CA

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