Crossing ticks – educating pet owners about tick paralysis in Australian dogs and cats

Candice Drew ISFM DipFN DipVN(surg) DipT(EC) RVN

Melbourne, Victoria, Australia

ABSTRACT: There are almost 900 recognised tick species worldwide. With increased human and animal travel there is a greater potential for pet owners and veterinary professionals to encounter ticks and tick-borne diseases they have not previously been exposed to, including Australian paralysis tick species. Veterinary nurses have an important role in recognising risks and signs of possible tick envenomation, in educating clients of these risks when travelling with pets, in early identification and treatment and in caring for patients experiencing signs of tick paralysis.

Keywords: Australian paralysis tick; tick envenomation; *Ixodes holocyclus*; *Ixodes cornuatus*; tick antitoxin serum; pet owner education; ectoparasite

Candice Drew ISFM DipFN DipVN(surg) DipT(EC) RVN

Candice qualified as a veterinary nurse in Australia in 2005, being awarded the Novartis Award for Outstanding Achievement in Veterinary Nursing in her qualifying year. She has worked extensively in Australia and the UK, primarily in referral nursing (Emergency & Critical Care). She attained the Diploma of Veterinary Nursing (surgical) in 2009, qualified as a trainer & assessor in 2015, and completed the ISFM Diploma in Feline Nursing in 2018. Candice is interested in most aspects of veterinary nursing but her passions are feline nursing, ECC, wildlife nursing, working with students and writing for pet owners.
Email: catrvn16@gmail.com

Introduction

Worldwide, the incidence of tick-borne diseases is increasing due to climate change, urbanisation of rural areas and movement of animals such as domestic pet travel and bird migration (Greay et al., 2016). These diseases are caused by the bacteria, viruses, protozoa and other parasites that ticks carry and transmit to the hosts they feed off (Gunn-Moore, 2019). Interestingly, tick preventative treatment is no longer a requirement of domestic pets travelling into the UK, although pet owners are still advised to "routinely treat their pet for ticks…especially if travelling abroad with their animals" (DEFRA, 2018). One of the tick-borne diseases of emerging importance is Lyme disease (*Lyme borreli* bacterium) which causes illness in dogs, cats, cattle and people (Lyme Australia, n.d.).

In Australia, there are approximately 100 species of tick. These are broadly divided into "soft ticks" (*Argasidae*) which affect birds and "hard ticks" (*Ixodidae*) which affect dogs and cats (BIAHA, n.d.). The most commonly encountered tick species in Australia are the Eastern paralysis tick (*Ixodes holocyclus*), Southern paralysis tick (*Ixodes cornuatus*), brown dog tick (*Rhipicephalus sanguineus)*, bush tick (*Haemaphysalis longicornis)*, and other ticks affecting our wildlife species. It can be difficult to distinguish between different tick species, however in Eastern paralysis ticks the 1st and 4th pairs of legs are darker than the middle legs, which aids identification (Figure 1).

Paralysis ticks are a major concern in some areas of Australia, particularly *Ixodes holocyclus*, which causes a progressive, ascending lower motor neurone (LMN) paralysis in the host (Padula et al., 2020). Tick paralysis in Australian domestic pets has been identified as a problem since the early days of settlement (Leister et al., 2018). Approximately 10,000 cats and dogs present to veterinarians for treatment for paralysis tick each year in Australia (Hall-Mendelin et al., 2011); farm and wildlife species can also be affected (Atwell, 2014; Hall-Mendelin et al., 2011; Padula, 2018). Due to human and pet travel, animals with tick envenomation can present to veterinary clinics in areas which are not endemic for paralysis ticks, leading to a delay in diagnosis and treatment due to the disease not being considered as a cause of clinical signs. For example, in 2013 a traveller returned to the UK from Australia and presented for medical treatment in London. The patient was treated for infected skin growths and skin tags which were later identified as a paralysis tick and tick crater (Pietzsch et al., 2014).

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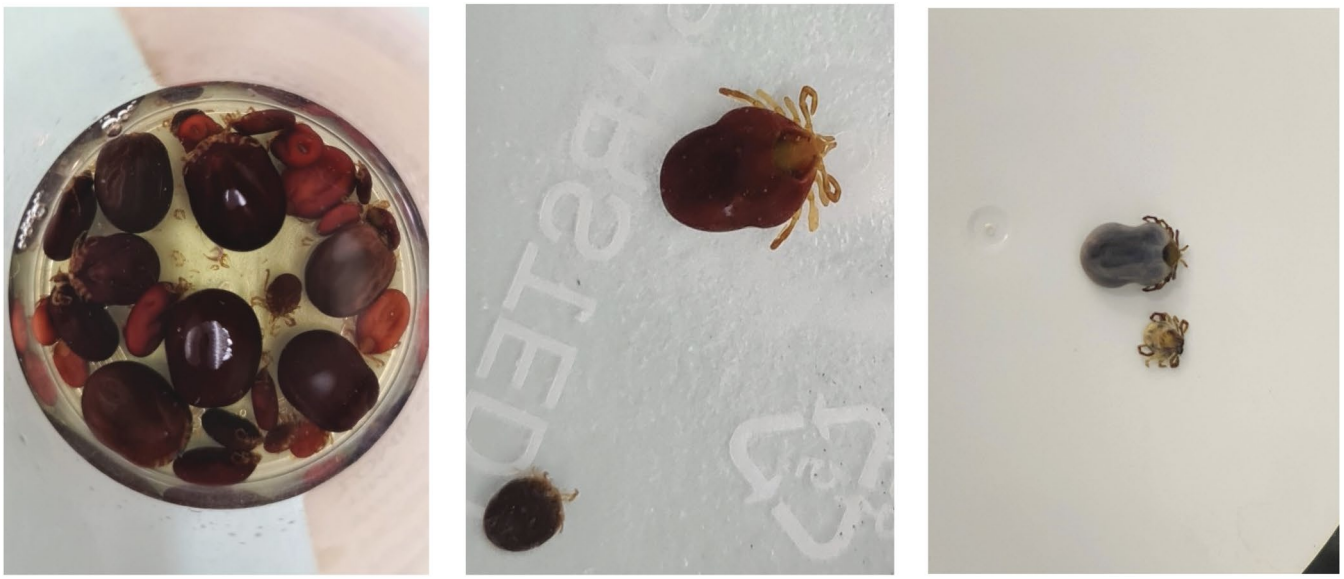

Photo courtesy of R. Dunford | Photo courtesy of R. Dunford | Photo courtesy of Dr A. Lloyd

Figure 1. Ticks in various levels of development and engorgement. The 1st and 4th pairs of legs in Eastern paralysis ticks are darker than the middle pairs.

Figure 2. Distribution of *Ixodes holocyclus* in Australia, and an engorged female paralysis tick. Image courtesy of Boehringer Ingelheim Animal Health Australia.

Paralysis tick prevalence, life cycle and features

Paralysis ticks are endemic along most of the east coast of mainland Australia, from Cape York in the north to Gippsland in Victoria (BIAHA, n.d.; Hall-Mendelin et al., 2011; Leister et al., 2018) (Figure 2). They live in areas which are warm and moist enough to maintain their life cycle. Melbourne occasionally sees dogs and cats affected by paralysis ticks, usually when dogs or their owners return to Melbourne from a known tick area. Melbourne does not have a climate which supports tick populations all year-around, because during Summer it is too dry for them. However, any stow-away ticks travelling to Melbourne can survive long enough to cause paralysis in the high-risk season (August-November in Melbourne; September – March in endemic areas) (Hall-Mendelin et al., 2011).

The paralysis tick life cycle is complicated and involves three hosts, primarily native wildlife species (Hall-Mendelin et al., 2011), particularly the bandicoot, at different stages of tick development. The entire life cycle takes one year.

Only adult female ticks are capable of causing signs of paralysis (BIAHA, n.d.; Hall-Mendelin et al., 2011; Leister et al., 2018; Lundgren, 2016). They are haematophagous obligate parasites and feed off the host using specialised mouth parts. 3–6 days after attaching, the female tick engorges and produces a neurotoxin in its salivary glands which is transferred to the host (Hall-Mendelin et al., 2011; Leister et al., 2018). (Note: this differs from paralysis ticks in the USA, with signs occurring 5–9 days post-tick attachment. Not all females in USA species produce toxin, and clinical signs in hosts tend to be less severe, with paralysis of the respiratory muscles occurring less often than in Australia) (Atwell, 2014; Lundgren 2016). Male ticks can occasionally be seen crawling in a host's fur, but they have shorter mouth parts than females and do not feed off the host.

Clinical signs in dogs

- LMN signs, particularly in the early stages
- Voice changes or loss of voice (due to laryngeal paresis)
- Hindlimb incoordination
- Dyspnoea
- Gagging, grunting or coughing
- Vomiting or regurgitation
- Dilated pupils
- Hypothermia.

Clinical signs in cats

Clinical signs in cats can vary from those in dogs. For example, cats affected by paralysis ticks often demonstrate signs of increased anxiety compared with dogs. Other signs in cats include:

- Obstruction of the upper respiratory tract (due to laryngeal paralysis)
- General respiratory distress, demonstrated as tachypnoea or increased respiratory effort, especially on expiration
- Cyanosis, indicating a severe lack of oxygen being delivered to the body's tissues. Veterinary advice should be sought immediately for any cat experiencing dyspnoea and/or cyanosis
- Coughing
- Voice changes

Photo courtesy of Dr A. Lloyd

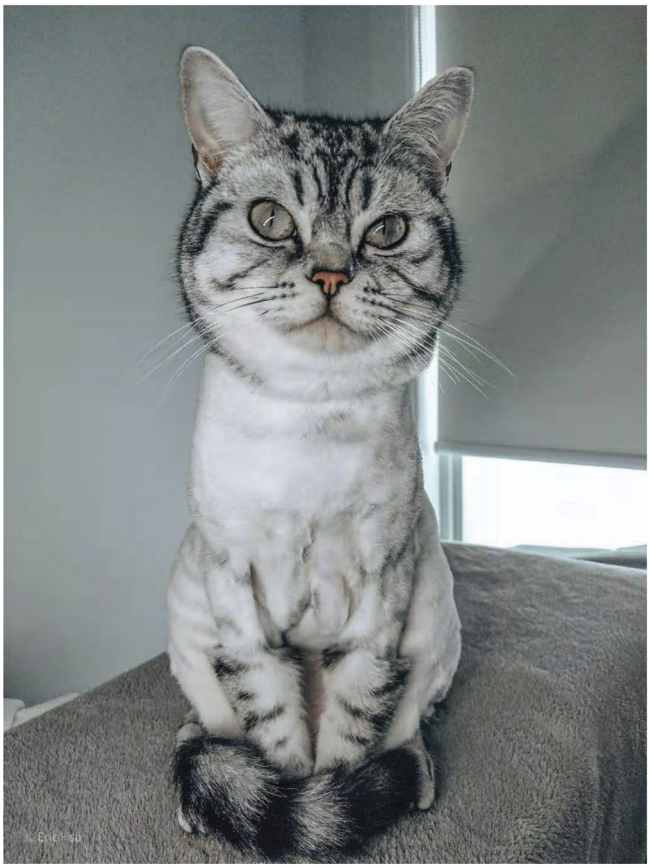

Photo courtesy of E. Hsu

Figure 3. Ticks are often easier to locate in short-coated breeds. The dog on the left has had a tick removed (in a sample bag next to the tick hook). The cat on the right has had his coat clipped in preparation for Summer.

- Difficulties controlling the legs, although the tail can be unaffected
- Difficulties with urination
- Hypothermia

(All clinical signs: APTAP 2019; Atwell, 2014; Hall-Mendelin et al., 2011; Leister et al., 2018).

Performing a tick search

If a pet is at risk of encountering ticks due to geographic location, climate conditions, time of year, lifestyle or contact with other at-risk animals, owners should perform a thorough daily tick search. During a routine nurse appointment, the veterinary nurse can demonstrate to clients how to perform a search. Because female ticks do not produce their neurotoxin until 3–6 days after attaching to a host, any ticks found during a daily search are unlikely to cause signs of paralysis. It is recommended that long-haired breeds are clipped during the tick season, to make searching easier (Figure 3).

The majority of ticks are found around the head, neck and front legs of the host (Figure 4) but they can be found anywhere on the body, (Atwell, 2014) so a thorough head-to-tail search is required. Pay particular attention to small crevices including the eyes, inside the nostrils, ears and mouth, under the pet's collar, the axillae, between the scapulae, between the toes and around the anus/prepuce/vulva, where ticks can lodge and be hidden from view.

Photo courtesy of N. Ruedisueli

Figure 4. The majority of ticks are found around the head and front legs of the host.

In addition to a visual search, use your fingers to "walk" through the fur and feel for lumps and other inconsistencies on the pet's skin. It is not uncommon to find skin tags and other growths such as fatty lumps, or tick craters where a tick was previously attached.

Different people should search the animal because everyone has their own method of searching, therefore one person might find a tick or a crater that another person misses.

For a tick search demonstration, please view this YouTube video: https://youtu.be/TiPB-fVJa2U

Advice to owners who find a tick on their pet

Any found ticks should be removed using either a commercially available tick hook, or by using the fingers in a twist-and-pull action (Figure 5). Advise owners to save the tick in a small container, to assist with species identification if needed, and estimation of how long the tick was attached to the pet by the level of engorgement. It is also crucial to keep searching the entire animal after finding a tick. While most cases involve a single adult tick, 40+ adults have been found on individual hosts (Leister, 2016).

If one or more ticks or a tick crater are found by a client during a daily search, the client should contact their local veterinary clinic for advice. Depending on the patient's individual circumstances, the veterinary surgeon (VS) might advise that the owner administers an acaricide immediately. They might also advise that the patient be monitored at home with food and water withheld for 12–24 hours, or that the patient is brought into the clinic (APTAP, 2019). The author's personal opinion is that if a patient needs hospitalisation for monitoring or treatment of tick paralysis, the clinic should be staffed 24 hours a day, or the patient be transferred to a 24-hour facility where it can be closely monitored overnight; respiratory distress and failure can occur rapidly and cannot be treated if there is no one on duty to notice.

It is crucial to remember that signs of paralysis can occur for up to 72 hours after a tick has been removed, which is why ongoing monitoring and tick searches are so important (search every 6–12 hours for the first three days if a tick or crater are found). Because cats, in particular, experience increased anxiety, it is important to keep them in a quiet and stress-free environment, which is temperature-controlled if possible, because additional stress hinders effective respiration and increases the demand for oxygen (APTAP, 2019).

If an animal is showing signs of tick paralysis, the owner should seek veterinary treatment immediately. In particular, any breathing difficulties can be life-threatening, especially if the pet (especially cats) is stressed or anxious. They need careful and calm handling during transport to a veterinary clinic, in a quiet and darkened environment (such as a towel over the pet carrier).

Figure 5. Tick removal. Source: iStock images.

Table 1. Determining severity of tick envenomation.

Gait score 1. Mild weakness 2. Can stand but not walk 3. Cannot stand but can right itself and maintain sternal recumbency 4. Unable to right itself; cannot maintain sternal recumbency
Respiratory score A. Normal B. Mild: increased respiratory rate and effort C. Moderate: any respiratory disease or difficulty breathing, restrictive breathing pattern, coughing, gagging or retching D. Severe: severe difficulty breathing, cyanosis, progressive reduction in respiratory rate, open-mouth breathing (Leister et al., 2018)

Treatment for tick paralysis

Detailed protocols are in place (APTAP, 2019) to guide veterinary personnel in the treatment of tick paralysis, and treatment recommendations vary depending on the severity of clinical signs. It is beyond the scope of this article to discuss treatment in detail, which concentrates on addressing clinical signs and providing supportive care for the patient (and the client).

Veterinary surgeons utilise two primary methods for assessing dogs and cats affected by paralysis ticks. These are the *gait score* and the *respiratory score* (Table 1). These scores will change, depending on whether the patient's condition is improving or deteriorating. Some patients might experience mild clinical signs only, and might be given a score of 1B (mild weakness and mild respiratory signs), whereas more severely affected patients might be scored as 3D or 4C. This scoring system guides the veterinary team in providing the most appropriate treatment, and monitoring response to treatment.

A common component of treatment in dogs and cats is the administration of *Tick Antitoxin Serum (TAS)* (Figure 6). TAS is a *hyperimmune canine serum*, taken from the blood of dogs which have developed an immunity to paralysis ticks. This is not a "tick vaccine" and does not provide future immunity, nor does it affect toxin which is already bound (causing damage) to the host's nervous system, so it does not result in immediate improvement of clinical signs in affected patients. The role of TAS is to neutralise any unbound toxin circulating in the host, preventing further signs

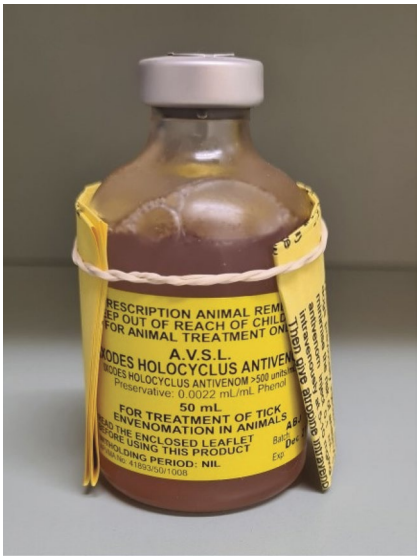

Photo courtesy of R. Dunford

Figure 6. Tick Antitoxin Serum.

of paralysis. Therefore, prompt administration of TAS, where required, results in the greatest benefit, prior to binding of the toxin.

Because TAS is a blood product, patients can have an anaphylactic reaction, similar to reactions associated with other blood product transfusions. This risk is increased in cats because TAS comes from dogs' blood. Not all dogs and cats will require TAS. If required, the dose and the number of doses depends on the animal's body size and the severity of clinical signs.

(For manufacturer information about TAS, see the Australian Veterinary Serum Laboratories website: https://www.avsl.com/avsl-ioxides-holocyclus-antivenom/).

Mortality rates

There is an increased risk of mortality:

- in patients with higher gait scores or respiratory scores (as described above)
- if the patient is hypothermic at initial presentation to the veterinary clinic
- if there is an anaphylactic reaction to the TAS. This risk is higher in cats than dogs and higher still if a cat has received a previous canine antiserum.

The risk of mortality is reduced:

- if fur is clipped (enabling ticks to be spotted sooner)
- if the patient receives TAS where necessary
- if the patient receives mechanical ventilation where needed

(APTAP, 2019; Atwell, 2014; Leister et al., 2018).

The prognosis is generally better for cats than for dogs. With appropriate veterinary treatment there is a 2% mortality rate in cats, as opposed to 6%–7% in dogs (APTAP, 2019; BIAHA, n.d.). The most common cause of death in cats is respiratory failure; for cats who require mechanical ventilation due to tick paralysis, the survival rate is 83.3% (APTAP, 2019). Therefore, life-saving treatment is available if initiated in time, however with extreme cases this treatment can be complicated, take time and be very expensive (not to mention extremely traumatic for both pet and owner).

How dog and cat owners can reduce the risk of tick paralysis

As with many conditions, the best treatment for ticks is prevention. Pet owners in high-risk areas can minimise risk by:

- reducing exposure to ticks by minimising outdoor access, particularly during peak times of the year
- keeping grass cut short and trim back overgrown foliage in the garden, where ticks are more likely to be found, and restricting cats' roaming
- regular application of an acaricide, all year around. There are numerous products on the market, some of which are combination products to address multiple parasite species. For cat owners, only recommend a product which is licenced for use in cats and which is effective against *Ixodes holocyclus* species. Some dog products contain permethrin or similar chemicals which are toxic to cats. Also take note of the "speed of kill" claims on the product label. These can vary for paralysis ticks as opposed to other tick species, and advise clients to follow all manufacturer directions for product use. Do not rely on acaricides as the sole method of prevention because they are not 100% effective.
- treat all in-contact animals
- performing a daily tick search, following a set pattern and utilising multiple people
- keeping the pet's fur short during high-risk times of the year.

Conclusion

If pet owners do find a tick(s) on their pet, early removal of the tick, +/- immediate treatment, results in a successful outcome in the majority of cases. If the pet is severely affected and requires intensive treatment and a long hospital stay, the chances of survival are still high. One barrier to successful (intensive) treatment is the associated cost, so having a contingency plan for veterinary emergencies, such as pet insurance, is imperative. It is additionally devastating to lose a beloved pet when the treatment is available but not affordable.

Communication between the veterinary clinic and clients is crucial, with the risk of tick paralysis being significantly reduced with effective preventative measures. As front-line representatives for the veterinary clinic, veterinary nurses and reception staff are in a position to convey vital information and provide life-saving education to clients about reducing risk and addressing known cases of tick infestation in their pets.

Disclosure statement

No potential conflict of interest was reported by the author.

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