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Distribution, seasonality and risk factors for tick paralysis in Australian dogs and cats

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ABSTRACT

Tick paralysis is a serious and potentially fatal condition of Australian companion animals induced by the paralysis ticks, *Ixodes holocyclus* and *Ixodes cornuatus*. Limited published information is available on the distribution, seasonality and risk factors for tick paralysis mortality in dogs and cats. This study describes 3479 cases of canine and feline tick paralysis in Australia using data extracted from a real-time disease surveillance program. Risk factors for mortality were identified, and maps of the distribution of cases were generated. Cluster analysis was performed using a space-time permutation scan statistic.

Tick paralysis was found to be distinctly seasonal, with most cases reported during spring. Most cases were located on the eastern coast of Australia with New South Wales and Queensland accounting for the majority of reported cases. A cluster of cases was identified on the south coast of New South Wales. Dogs were found to be at significantly higher risk ($P < 0.05$) of death if less than 6 months of age or if a toy breed. No significant risk factors for mortality were identified for cats. Some animals receiving chemoprophylactic treatment for tick infestation experienced tick paralysis during the products' period of effectiveness.

There is a high risk of tick paralysis in dogs and cats on the eastern coast of Australia during the spring months. The risk factors for mortality identified can be used by veterinarians to determine prognosis in cases of canine tick paralysis and potentially to improve the treatment of cases. Daily tick searches of pets – particularly in high risk areas and during high risk periods – are recommended since the prevention of tick paralysis via chemoprophylaxis is not 100% guaranteed across the whole population.

1. Introduction

Tick paralysis is a neuromuscular disorder resulting from envenomation by species of *Ixodes* ticks (Masina and Broady, 1999). The condition typically presents as a rapid ascending flaccid paralysis. Death usually results from paralysis of respiratory muscles. Other typical clinical signs that may be seen include a change in voice, vomiting, inappetance and anisocoria (Stone et al., 1989). Some *Ixodes* ticks, like I holocyclus, do not secrete cementum to attach to their host at the blood feeding site (Stone et al., 1989; Pearn, 1977; Masina and Broady, 1999). Since male tick mouthparts are of inadequate length to penetrate skin, only females are capable of inducing paralysis (Masina and Broady, 1999). Clinical signs of paralysis are not apparent until 3 days after tick feeding begins, becoming more severe after the fourth day of attachment (Goodrich and Murray, 1978). This onset of clinical signs correlates with an increase in salivary gland size in the feeding tick (Masina and Broady, 1999).

Tick paralysis has been reported worldwide, and the Pacific Northwest coast of the United States and the Australian east coast have been identified as disease hot spots (Edlow, 2010). The species of paralysis tick varies by region:

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Dermacentor andersoni and *D. variabilis* in North America, *Ixodes rubicundus*, *Rhipicephalus evertsi evertsi* and *Argus walkerae* in Africa (Masina and Broady, 1999) and *Ixodes holocyclus* and *Ixodes cornuatus* in Australia.

Tick paralysis affects both humans and animals (Pearn, 1977). The first Australian report in animals was by Backhouse in 1843 (cited by Ross, 1926), who described the condition in sheep and calves. The first experimentally induced case of tick paralysis was reported in 1921 by Dodd (cited by Ross, 1926). Initially, paralysis in Australia was suspected to be associated only with *I. holocyclus*, however *I. cornuatus* was subsequently implicated in Victoria and Tasmania (Roberts, 1960; Storer et al., 2003; Jackson et al., 2007). Nonetheless, *I. holocyclus* is considered the most important species causing tick paralysis in Australia (Stone et al., 1989; Masina and Broady, 1999). Most studies of tick paralysis in companion animals have focused on dogs only. Reports in cats have been limited to case series or anecdotal descriptions. Despite this, tick paralysis is still considered a common condition of cats on the eastern seaboard of Australia, although the prevalence is unknown (Schull et al., 2007).

In Australia it is thought that the distribution of *I. holocyclus* closely follows that of alternative host species, including native bandicoots, koalas and possums (Stone et al., 1989). These hosts are less susceptible to the effects of the tick's neurotoxin (Stone et al., 1989; Masina and Broady, 1999). Cases reported on the east coast of New South Wales and Queensland have commonly been associated with bandicoots (Masina and Broady, 1999; Jackson et al., 2007). The distribution of *I. holocyclus* is reported to range from Cairns in northern Queensland to Bairnsdale in southeast Victoria, more likely in areas of coastal scrubland (Storer et al., 2003).

The geographical distribution of tick paralysis is not just based on the presence of alternative hosts. Climate and vegetation are also thought to play a role, with high humidity and the presence of low vegetation (to provide shelter for ticks) associated with more tick paralysis cases (Taylor et al., 2007). It is generally accepted that tick paralysis is highly seasonal, with the majority of cases reported in the warmer months (Jackson et al., 2007) of spring and early summer when female tick numbers peak (Masina and Broady, 1999). One study (Atwell et al., 2001) has investigated possible risk factors (weight, age, sex, and coat length and thickness) for tick paralysis. Only age (older dogs) was found to be associated with increased mortality.

With potentially dire outcomes from tick paralysis, prevention is the focus for pets in high risk areas. Common forms of prevention include daily searches of the animal's coat for ticks and subsequent removal and administration of acaricidal products (including oral products such as cythioate and topical products such as fipronil and pyrethrin-based formulations) (Masina and Broady, 1999; Atwell et al., 2001; Schull et al., 2007).

Tick paralysis is just one of many important companion animal diseases. To monitor companion animal diseases, a voluntary disease surveillance program called Disease WatchDog was launched in January 2010 (Ward and Kelman, 2011; www.diseasewatchdog.org). The program involves registered veterinarians and their staff logging disease cases-including canine parvovirus, canine distemper, canine cough, canine hepatitis, feline calicivirus, feline herpesvirus, feline infectious peritonitis, feline leukaemia virus and tick paralysis. Tick paralysis was not initially included in the list of reportable diseases but was introduced with the release of version 2.0 of the program in September 2010 (Ward and Kelman, 2011).

Considering the importance of tick paralysis to companion animal health and the lack of detailed scientific data on its distribution and associated risk factors for mortality, the aim of this study was to describe the distribution of tick paralysis in Australia using a real time surveillance system, and to identify risk factors for mortality from tick paralysis. The results will aid veterinarians in the diagnosis, control and treatment of tick paralysis by raising awareness of the condition and identifying high risk areas.

2. Materials and method

2.1. Data collection

Data were extracted from Disease WatchDog (www.diseasewatchdog.org). This voluntary disease surveillance program was developed to address a lack of monitoring of companion animal diseases and to provide a method for real time surveillance and mapping of current (as well as previous) disease occurrences. Only registered veterinarians and nursing staff can log cases, enhancing the accuracy of the data collected. A range of case details are recorded, including patient information (name, sex, breed, age, neuter status), clinic information (veterinary clinic and veterinarian's name), case location (suburb, state, postcode) and case information (case date, method of diagnosis, case outcome and vaccination status and date). From this program a total of 6685 companion animal disease case reports were available for the period 4 April 2009 to 28 January 2012. A total of 3542 tick paralysis cases were identified from this dataset. These tick paralysis cases were reported during the period 10 January 2010 to 28 January 2012 and included both feline and canine cases.

In Disease WatchDog each case report can contain information on the reporting clinic (postcode; suburb; state; clinic name; reporting veterinarian) and patient information (name; species; breed; sex; age; neuter status). Information on case diagnosis (clinical presentation: tick crater only; tick found; other), case outcome (euthanized; died; treatment ongoing; recovered; animal tested positive but not clinically affected),treatment status (treated; untreated; treatment unknown) and treatment type (Advantix®;Proban®; Frontline Plus®; Frontline® Spray; Kiltix®; Preventic®; Gamma Wash®; other) is entered online via a dropdown box. If "other" treatment is selected, reporting veterinarians must specify the treatment as free-field text. The program also provides the option of reporting cases in batches. Batch case reports contain information on the reporting clinic (postcode; suburb; state; clinic name), limited patient information (species) and case information (case date; method of case diagnosis; number of cases per batch). This provides a rapid way to enter multiple cases, however less specific data are provided.