

Prevalence of ticks (*Rhipicephalus sanguineus*) in dogs from an urban Mexico-U.S. border region: a pilot study

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Abstract

The objective of this pilot study was to estimate tick prevalence in dogs from the urban area of Mexicali, Baja California, a Mexico-U.S. border region. A total of 94 dogs were used from private practice veterinary clinics and the Veterinary Center for Rabies Control. The pilot study was carried out during autumn 2003. Risk factors considered within the study were origin group, sex, age and size. The association between potential risk factors and the probability of an animal being tick positive was evaluated using χ^2 and OR. Results of the study indicate that 59.6% of the dogs were positive to tick presence. One hundred percent of collected ticks were identified as *Rhipicephalus sanguineus*. Body regions that were most infested were ears, interdigital spaces of limbs and back. Sampled dogs had different degrees of infestation. Dogs ≤ 1 year old had higher tick prevalence (73.6%) and different than older dogs ($P < 0.05$), being 2.8 times more susceptible ($P < 0.01$) to infestation by ticks (95% CI 1.14-6.83).

Key words: tick, prevalence, risk factors, zoonosis, diseasesm, *Rhipicephalus sanguineus*.

Introduction

Ticks are the second most important group of arthropod vectors of diseases transmissible to animals and man. They are obligate parasites and just in one bite while feeding on the host may transmit diverse pathogens such as bacteria, spirochetes, *Rickettsia*, protozoa, virus, nematodes and toxins. Among the diseases most commonly transmitted to man are Lyme disease, ehrlichiosis, babesiosis, Rocky Mountain Fever, Colorado Tick Fever, tularemia, Q fever, tick paralysis, spotted fever and tick encephalitis. At the same time, ticks may facilitate secondary infections and allergic reactions to protein in the saliva they produce (Edlow 1999; Spach and others 1993).

Likewise, ticks can be a zoonotic risk since they may be found in homes where they can come in contact with humans while searching for environmental favorable conditions to subsist (Cruz-Vazquez and Garcia-Vazquez 1999; Gaxiola and others 1997; Quintero and others 2004).

The tick *Rhipicephalus sanguineus* is distributed worldwide and has been implicated as vector of several pathogens, including *Rickettsia rickettsii* and *Ehrlichia canis*. (Marquez-Jimenez and others 2005; Merino and others 2005). *R. sanguineus*' life cycle may require up to two years to be completed, beginning with egg formation, larva, nymph and adult stages, in each of which pathogens may be transmitted. (Spach and others 1993). *R. sanguineus* adults are most frequently found in ears and interdigital spaces of dogs. Larvae and nymphs adhere easily to long hair of the back or neck. Their life cycle includes three hosts since the three tick stages (larva, nymph and adult) must feed on the host (Quiroz 1999).

The objective of this pilot study, was to estimate tick prevalence in dogs from the urban area of Mexicali, Baja California, a Mexico-U.S. border region; and assess the association between risk factors and positive tick results.

Methodology

This pilot study was performed during autumn, from the 1st of September to the 30th of November 2003, in the urban zone of Mexicali, Baja California, Mexico. The purpose of this pilot study was to determine the feasibility of performing a complete study and define the appropriate sample size.

Mexicali, capital of the State of Baja California, Mexico, is located in the northwest of the country at 32° 40' North latitude, 115° 28' West longitude, with 895,962 inhabitants (Wikipedia 2006). Climate is extreme, desert type. Seasonal behavior of average maximum and minimum temperatures is shown in Table 1.

Average annual rainfall is $0.63 \pm .43$ cm. Climatic conditions' data was collected from the United States *National Weather Service* of the *National Oceanic and Atmospheric Administration* (<http://www.nws.noaa.gov/>).

Study subjects included a total of 94 dogs, distributed in two groups: 54 dogs came from any of the 10 private urban veterinary clinics of the city, having been taken there for any reason and 40 dogs captured by personnel of the Veterinary Center for Rabies Control. Selection criteria for the dogs were: at least one month old, not taking into consideration breed, size or sex. Dogs were randomly selected from each group. All selected dogs were examined for ticks on the following regions: face, ears, neck, back and limbs (interdigital spaces) and the number of ticks per region were recorded on a diagram. Dogs that had at least one tick were considered positive. The degree of infestation was determined based on tick count per subject, without taking into consideration the region (Table 2).

Tick collection was performed by a Veterinary Doctor following the procedures described above (Farley 1996; Lyon and Restifo 2000). Samples were sent to the Molecular Biology Laboratory of the Veterinary Science Research Institute of the Autonomous University of Baja California in 70% ethanol in sterile 15 ml collector tubes with sealing cap. Taxonomic identification was performed by stereoscopic observation (Quiroz 1999).

Recorded variables per study subject were: identification, sex, age, size; group of origin, body region and degree of infestation.

Prevalence by study factor and total prevalence were estimated with the generated information that was captured. Prevalence values within each factor were compared by χ^2 . Likewise other variables were evaluated such as sex, age, size and group taken as risk factors by association with tick positive results by using odds ratio analysis in 2 x 2 tables (Walker 1997). All statistical analysis were performed using the SAS statistical package version 9.1 (SAS 2004).

Results

At least one tick was found in 59.6% (56/94) of sampled dogs. There were no significant differences ($P > 0.05$) between prevalence of both groups. One hundred percent of collected ticks from the study subjects were identified by morphology as *Rhipicephalus sanguineus*.

In relation to tick location on the dog, most of them were found on ears with 30.8% (29/94), followed by the limbs (interdigital spaces) with 28.7% (27/94) and dorsal region with 24.4% (23/94), and to a lesser degree they were found on neck with 11.7% (11/94) and on the face region with 6.3% (6/94).

In the pilot study, 46.8% (44/94) of the dogs had a slight infestation, 9.6% (9/94) had a medium infestation and 3.2% (3/94) had a severe infestation, and 40.4% (38/94) were not infested.

Dogs ≤ 1 year old had greater tick prevalence (73.6%) and different ($P < 0.05$) to the estimate for older dogs (50%). Dogs ≤ 1 year old are 2.8 time more susceptible of being infested with ticks than older ages (Table 3).

No differences were observed ($P > 0.05$) in prevalence values in relation to sex and size of the dogs.

Discussion

Results of this pilot study in Mexicali, B. C. that was carried out in autumn, indicate that there is a high prevalence of ticks in dogs, greater than the prevalence reported for *Rhipicephalus sanguineus* found in Culiacán, Sinaloa, Mexico (46%) (Gaxiola and others 1997), in Cuernavaca, Morelos, Mexico (20%) (Cruz-Vazquez and Garcia-Vazquez 1999), as well as in Israel (16-34%) (Mumcuoglu and others 1993), in Brazil (27%) (Szabo and others 2001), in Nigeria (19.5%) (Ugochukwu and Nnadozie 1985), in Japan (4.8%) (Shimada and others 2003) and in Italy (19.7%) (Tringali and others 1986).

Ticks were identified as *R. sanguineus* in 100% of the infested dogs, as has been reported in other regions such as Brazil (Szabo and others 2001), Mexico (Cruz-Vazquez and Garcia-Vazquez 1999) and also Mexicali, B. C., (Quintero and others 2004). This species is potentially capable of biting humans and transmitting zoonotic diseases such as ehrlichiosis, and rickettsiosis (Carpenter and others 1990; Dantas-Torres and others 2006; Marquez-Jimenez and others 2005; Merino and others 2005; Quintero and others 2004). In Italy reported about 500 human tick bites per 100,000 residents, and 10% of these tick bites are attributed to *R. sanguineus* (Manfredi and others 1999) with the respective tick-borne zoonosis transmission risk. Also, it is important that underline a study done in the Mexican Republic that reported 33.1% general seroprevalence of *Ehrlichia canis* in dogs, while for the State of Baja California the value was 70.2%. In another study in Mexicali, 98% (28/30) of sampled dogs were seropositive to *Ehrlichia canis* and 16.6% (5/30) to *Rickettsia rickettsii* (Romano and others 1998). Another study indicated 49.3% (95% CI 30.8-54.1) adjusted prevalence to *Ehrlichia canis* in 94 dogs in the same city (Tinoco-Gracia and others 2007a).

On the other hand, young animals in this study were found (< 1 year) more susceptible than older dogs, and as age increases also number of exposures to ticks increases. This situation could be due to resistance to reinfestations with *R. sanguineus* due to their immunological status (Inokuma and others 1997).

Another significant observation was the preference of ticks for certain location sites on the dog, that are ears, limbs (interdigital spaces) and back which coincides with previously published studies (Papazahariadou and others 2003), and ears coinciding with another study that also includes abdomen as a site of preference (Mumcuoglu and others 1993). Probably these sites are preferred because they are less accessible for the dog to remove them with his paws, as compared to other places, such as neck or face.

In this study, slight tick infestation of the dogs was most frequently found, when compared to medium and severe infestations; but it must be taken into consideration that sampling was done during autumn, season that by prior biological cycle studies is known as a period where its presence on the dog is reduced to protect itself from non-favorable environmental conditions (Quiroz 1999), of low temperatures during autumn and winter, time when it moves to places where it can protect itself such as floor and wall crevices and shutters (Quintero and others 2004).

Other important data that should be taken into account are the serological evidences that have been published on *Borrelia burgdorferi* in dogs of the Mexicali urban areas as reported in two previous studies that showed similar prevalence, 6.6% (2/30) (Romano and others 1998) and 8.2% (95% CI 1.5-13.3), respectively (Tinoco-Gracia and others 2007b). Therefore, since at this time a vector has not been proven as such, *R. sanguineus* could be responsible for the transmission of *B. burgdorferi*.

These results and the implications of transmission of pathogens by ticks, suggest the need for further studies to understand comprehensively all aspects such as definitive diagnosis, culture and molecular biology of the involved zoonotic diseases, as well as the structuring of epidemiological studies (frequency, distribution and risk factors) of these diseases in the region, in order to design preventive medicine programs. It will be important to instrument fumigation campaigns, deworming calendars, education campaigns for the public, related with the zoonoses transmission risks and tick presence prevention. Finally, it will be necessary the active participation of veterinarians, doctors, epidemiologists, public and private health sector, as well as the community in general is promoted.

TABLES

Table 1. Average maximum and minimum temperatures per season each year in Mexicali, B.C., Mexico.

Season	Maximum Temperature	Minimum Temperature
Spring	34.6 ± 4.7 °C	16.1 ± 3.9 °C
Summer	40.3 ± 1.8 °C	23.7 ± 1.7 °C
Autumn	26.5 ± 5.9 °C	9.4 ± 5.1 °C
Winter	23.7 ± 2.5 °C	7.2 ± 2.2 °C

Table 2. Definition of degree of tick infestation per dog

Degree of infestation	Criteria (tick count)
Light	1 to 10
Medium	11 to 30
Severe	> 30

Table 3. *Rhipicephalus sanguineus* tick prevalence in dogs by age group in Mexicali, B. C., Mexico.

Age group	n	Positive	Prevalence %
≤ 1 year old	38	28	73.6 ^a
> 1 year old	56	28	50.0 ^b
Total	94	56	59.6

OR= 2.8 (CI 1.14-6.83).

Different literals in column indicate difference ($P < 0.05$).

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