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Elevated Lyme Disease Seroprevalence Among Dogs in a Nonendemic County: Harbinger or Artifact?

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Abstract

Lyme disease, a tick-borne illness caused by *Borrelia burgdorferi*, infects humans and other species, including dogs. Canine seroprevalence has been suggested as a sentinel marker of human disease risk. A recent publication reported high canine seroprevalence (> 5%) in Routt County, Colorado, an area where Lyme disease is generally considered nonendemic. We surveyed veterinarians in Routt County and discovered that 11 of 12 seropositive dogs (> 90%) had a documented history of travel to or residence in a Lyme disease endemic area. These findings do not support the presence of an undocumented disease focus and reveal that despite its high sensitivity, there are limitations in the specificity and positive predictive value of elevated canine seroprevalence as a marker of human risk.

Keywords

Lyme disease; *Borrelia burgdorferi*; Seroprevalence; Nonendemic area

Introduction

Lyme disease is a tick-borne illness caused by certain genospecies of *Borrelia burgdorferi*. Areas of known transmission include the northeastern, mid-Atlantic, and north-central United States where the vector is *Ixodes scapularis*, and California, Oregon, and Washington where the vector is *I. pacificus*. Disease manifestations in humans include erythema migrans, carditis, arthritis, and neurologic abnormalities. Domestic dogs are also highly susceptible to infection, although clinical illness is less common (Little et al. 2010).

Routt County is a small rural county in northwestern Colorado where transmission of *B. burgdorferi* to humans has never been documented, and known tick vector species have not been identified (Dennis et al. 1998). In 2009, Bowman and colleagues reported that over 5% of Routt County dogs tested had detectable antibodies to *B. burgdorferi* (Bowman et al.

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2009). These results were based on a nationwide convenience sample of dogs tested using IDEXX SNAP® tests, which simultaneously detect infection with *Dirofilaria immitis*, *Ehrlichia canis*, and *B. burgdorferi*. This publication, in conjunction with a map on an IDEXX website showing 17 seropositive dogs in Routt County (IDEXX 2010), generated concern that a previously unrecognized enzootic cycle of *B. burgdorferi* with consequent risk of human infection was present in Colorado. To assess this possibility, we conducted a survey of Routt County veterinarians.

Materials and Methods

In collaboration with the Colorado Veterinary Medical Association, we obtained contact information for all known licensed veterinary practitioners in Routt County. In June, 2010, each practice was contacted by telephone to determine if they provided service for canines, and, if so, whether they ever had a patient that tested positive for Lyme disease. Veterinarians that met these criteria were asked to complete a brief written survey, referring as needed to medical charts or electronic clinic records. Questions concerned practice characteristics, the number of dogs testing positively for Lyme disease during the preceding decade (2001–2010), and the clinical features, tests used, and travel history of any seropositive dogs. Surveys were administered using a combination of telephone, e-mail, and fax.

Results

Sixteen of 20 veterinary practitioners licensed in Routt County were contacted successfully; the remaining 4 could not be located. Ten practitioners reported treating canines. Two did not report ever having a seropositive dog in their practice and were not queried further. All of the remaining 8 practitioners agreed to participate in the survey.

Participating practitioners were associated with 3 clinics, each treating ≥500 dogs annually. Participants identified a total of 12 dogs that tested positively for antibodies to *B. burgdorferi* during the 10-year period. Positive results were obtained with IDEXX SNAP® 3Dx®, 4Dx®, and IDEXX Lyme Quant C6® tests, as well as 1 unspecified off-site diagnostic test. Eleven (92%) of the dogs had a history of residence in a state where Lyme disease is known to be highly endemic (Maine, New Jersey, Connecticut, Maryland, or Minnesota). The remaining seropositive dog had a “low titer” when tested with the IDEXX Lyme Quant C6® test, despite having no documented history of travel outside of Colorado and no clinical signs. Additionally, this dog reportedly tested positively for *Rickettsia rickettsii* and an *Ehrlichia* species using an unspecified IDEXX tick panel.

Discussion

Dogs have been proposed as sentinels for Lyme disease risk based on their proclivity for tick bites and a robust antibody response following infection (Rand et al. 1991, Duncan et al. 2005, Little et al. 2010). High seroprevalence rates of 7–18% among dogs in endemic states support the view of canine serology as a sensitive tool for identifying areas with infected ticks (Bowman et al. 2009; Mead et al. 2011). Our investigation concerns an alternate characteristic, the specificity of high canine seroprevalence as a marker of risk. We surveyed

veterinarians in a county with no prior recognized Lyme disease risk and found that all but 1 of 12 seropositive dogs had a documented history of prior travel to or residence in a highly endemic area. The 12th dog was seroreactive to *B. burgdorferi* and 2 other diseases rarely seen in Colorado, suggesting either a highly unusual exposure history, or perhaps some immunological characteristic leading to nonspecific reactivity. Regardless, our findings do not support the existence of an undocumented enzootic cycle of Lyme disease in Routt County.

Our investigation is subject to several limitations. We did not determine the total number of Lyme disease tests performed in the county and cannot validate the >5% seroprevalence previously reported (Bowman et al. 2009). Whereas the IDEXX website listed a total of 17 positive results from Routt County between 2001 and 2009 (IDEXX 2010), we were only able to identify 12 seropositive dogs. Nevertheless, we have no reason to suspect differential ascertainment of dogs with a history of travel, and the overall conclusion is likely unaffected.

Canine seroprevalence data are sometimes touted as less subject to misrepresentation as compared to human disease surveillance data, due to presumption of more limited animal movement (Duncan et al. 2005). Travel-related exposures, small sample sizes, and selective testing of dogs with the potential for previous exposure, however, can generate high rates of seropositivity that do not accurately reflect local risk. In this regard, maps of canine seroprevalence are subject to some of the same limitations as those of human surveillance data. Proper interpretation of elevated canine seroprevalence requires an appreciation of both its sensitivity and potential specificity. As a sensitive but potentially nonspecific marker of risk, the greatest utility of canine seroprevalance information lies in validation of low risk in areas where the disease does not occur.

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