SEROPREVALENCE OF BORRELLIA BURGDORFERI IN HORSES IN MINNESOTA

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ABSTRACT

To determine the seroprevalence of B. burgdorferi in horses in Minnesota, the database of the Veterinary Diagnostic Laboratory, University of Minnesota, was searched over a ten year period (2001- May 2010). A total of 1,260 equine serum samples submitted by 112 veterinary clinics were tested using an indirect fluorescent antibody test. Samples with titers of ≥1:320 were considered positive. The average rate of seroprevalence was 58.7% indicating high exposure of horses to B. burgdorferi in Minnesota. Our results indicate that Borreliosis should be considered as a differential in cases of horses with undiagnosed musculoskeletal or neurologic disease.

Key words: Lyme borreliosis, Horses, Borrelia burgdorferi, IFA test.

INTRODUCTION

Lyme disease is the most prevalent tick-borne zoonosis in Europe and America (Korenberg et al., 1993). It is a multisystemic disease caused by the spirochete Borrelia burgdorferi and has been reported in humans and animals including dogs, cattle, and horses (Blowey et al., 1994; Weaver, 1997). In horses, borreliosis was first reported in 1978 in South Africa and was serologically confirmed from the Baltics to the Far East by the beginning of 1992 (Masuzawa, 2004). The rate of seropositivity in horses in Europe ranges from very low to 68% (Goossens et al., 2001), which is higher than in Wisconsin (63%) (Salinas-Melendez, 2005) and Texas (0.2%) (Cohen et al., 1992) but lower than in Connecticut (84%) (Salinas-Melendez, 2005).

Minnesota provides a suitable habitat for several tick species particularly Ixodes scapularis, which is a competent vector for B. burgdorferi (Magnarelli et al., 1988). Urine from infected cattle (Burgess et al., 1986), horses (Tara et al., 1998) and white-footed mice (David et al., 1996) is considered as a source of infection for animals. Transmission of disease from a seropositive, subclinical horse to a human by means of a bite was reported in 1987 from Belgium (Malloy et al., 1990) but this route of transmission needs to be confirmed and further studied.

The counties in northcentral, eastcentral, southeastern and northwestern Minnesota are at a high risk for tick exposure due to the presence of woodlands and forests. The risk of borreliosis from these ticks is the highest during spring, early summer, and fall months. Larval ticks hatch from eggs and become infected with B. burgdorferi after feeding on infected rodents. The larval ticks then transmit the infection to new hosts during a subsequent blood meal (Wormser et al., 2006). Rodents, especially the white-footed mouse, serve as the natural wildlife host of the ticks. Nymphs feed on a variety of wild and domestic species, including rodents, horses, cats, birds and even humans. Deer are the predominant wildlife host for adult ticks but domestic animals such as horses, cattle and even cats may serve as substitute hosts (Piesman and Eisen, 2008). Horses living in endemic regions may become infected from adult Ixodes ticks (Anthony et al., 1991).

Only 10% of the seropositive horses are reported to develop clinical signs (Bushmick, 1994) including lameness with or without joint swelling (Post, 1990). Less frequently, laminitis, uveitis, abortion, weight loss, encephalitis, foal mortality, neurological signs and blindness have been reported as a consequence of Lyme disease (Egenvall et al., 2001). Clinical diagnosis is particularly difficult in horses because lameness can also occur as a part of other musculoskeletal disorders (Madigan, 1993). This retrospective study was conducted to determine the serological prevalence of B. burgdorferi in Minnesota horses.

MATERIALS AND METHODS

Source of Samples: Serum samples from horses submitted to the Veterinary Diagnostic Laboratory at the University of Minnesota over a ten year period (2001- May 2010) were included in this study. During this period, a total of 1,260 equine samples from 112 veterinary clinics were obtained and tested.

Indirect Fluorescent Antibody Test: Serial dilutions of serum samples (1:40, 1:80, 1:160, 1:320, 1:640 and 1:1,280) were prepared in phosphate buffered saline (PBS) and 20µl of each dilution was transferred to Lyme antigen coated wells on a slide (Fuller Laboratories, Fullerton, CA). Both positive and negative controls were
Results and Discussion

Of the 1,260 samples, 739 (58.7%) were positive for antibodies to *B. burgdorferi* at titers of ≥1:320 (Table 1). The highest prevalence (93.9%) was recorded in 2009 while the lowest (21%) was in 2001. From January to May of 2010, 92% of the samples were positive for *B. burgdorferi* antibodies. In general, the proportion of positive samples continued to increase each year. Similar trends have been reported in previous studies. For example, a serosurvey in northeastern USA showed 45.1% seropositive horses in 2001 (Magnarelli and Fikrig, 2005) as compared to 14-24% in earlier studies (Bushmick, 1994; Magnarelli et al., 1988).

The rate of seroprevalence reported in our study is higher than the 33% reported in France (Laurent et al., 2009), 6.8% in Sweden (Egenvall et al., 2001), 16% in Berlin (Käsbohrer and Schönberg, 1990), 34% in Mexico, and 6% in Turkey (Bhide et al., 2008). However, our seroprevalence rates are similar to those reported in Austria (60-90%; Müller et al., 2002); Wisconsin (63%) and Connecticut (84%; Salinas-Melendez, 2005); and New Jersey (60%; Cohen et al., 1986). It should be noted that samples in our study came from animals that had an underlying disease problem; hence higher rate of seroprevalence.

The risk of Lyme borreliosis in Minnesota may be attributed to the existence of favorable habitat for ticks. David et al. (1996) observed that natural foci of Lyme borreliosis existed in New England, Wisconsin, Minnesota, northern California and parts of the southeastern United States. The enzootic transmission cycles with different species of *Ixodes* ticks (*I. dammini, I. scapularis* and *I. pacificus*) and mammalian reservoirs show that the number and spread of ticks and infection with *B. burgdorferi* have increased in endemic areas of Lyme disease (David et al., 1996). These findings have supported the present study, which showed an increasing trend of seroprevalence (21% in 2001 compared with 93.9% in 2009).

During the present study, IFA test was used for the detection of *B. burgdorferi* antibodies. Serology by IFA test is a widely employed tool in diagnostics and epidemiological surveys (Littman et al., 2006) and has been used for the detection of *B. burgdorferi* antibodies in horses (Magnarelli et al., 1988 and 2005). The sensitivity of IFA has been reported to be 96% with 89% specificity (Egenvall et al., 2001). In the present study, titers of ≥1:320 were considered as positive. In previous studies, many different cut-off points have been used for this test. For example, IFA titers of 1:128 (Käsbohrer and Schönberg, 1990), 1:120 (Post, 1990), 1:140 (Magnarelli et al., 1988), and 1:256 (Marcelis and Marneffee, 1987; Cohan et al., 1986) have been used to indicate positivity. Egenvall et al. (2001) reported average titers of 1:103 (range 1:80 to 1:320) in healthy horses as compared to 1:107 (range 1:80 to 1:1,280) in clinical cases. We used 1:320 as a conservative cut-off for indicating infection.

### Table 1: Seroprevalence of Lyme borreliosis in horses in Minnesota from 2001- May 2010.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of serum samples examined</th>
<th>Number positive</th>
<th>Per cent positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>167</td>
<td>35</td>
<td>21.0</td>
</tr>
<tr>
<td>2002</td>
<td>52</td>
<td>43</td>
<td>82.7</td>
</tr>
<tr>
<td>2003</td>
<td>88</td>
<td>69</td>
<td>78.4</td>
</tr>
<tr>
<td>2004</td>
<td>138</td>
<td>89</td>
<td>64.5</td>
</tr>
<tr>
<td>2005</td>
<td>386</td>
<td>167</td>
<td>43.3</td>
</tr>
<tr>
<td>2006</td>
<td>121</td>
<td>98</td>
<td>81.0</td>
</tr>
<tr>
<td>2007</td>
<td>116</td>
<td>67</td>
<td>57.8</td>
</tr>
<tr>
<td>2008</td>
<td>87</td>
<td>73</td>
<td>83.9</td>
</tr>
<tr>
<td>2009</td>
<td>66</td>
<td>62</td>
<td>93.9</td>
</tr>
<tr>
<td>2010</td>
<td>39</td>
<td>36</td>
<td>92.3</td>
</tr>
<tr>
<td>Total</td>
<td>1260</td>
<td>739</td>
<td>58.7</td>
</tr>
</tbody>
</table>

It was suggested by Dzierzecka and Kita (2002) that interpretation of signs and serologic test results should be made with consideration of the regional prevalence as well as the animal’s opportunity for exposure to infected *Ixodes* spp. We conclude that horses in Minnesota are exposed to *B. burgdorferi* and this exposure has increased over the years. Although this is a serological study, which may or may not indicate active infection, it is prudent for veterinarians to be cognizant of the increased spread of this disease along with dispersal to a variety of domestic animals including horses. It is also advisable to include Lyme disease as a differential diagnosis in cases of undiagnosed musculoskeletal or neurologic disease. With the current status of borreliosis in horses, it is clear that maintaining epidemiological data is necessary for effective control and prevention of *B. burgdorferi* in horses in Minnesota.
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REFERENCES


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