Seroprevalence of *Babesia microti* in Individuals with Lyme Disease

Sabino Curcio¹, Laurel Tria² and Azad L. Guca³

¹Department of Biomedical Sciences, Long Island University, Post Campus, Brookville, NY
²Northwell Health Laboratories, Lake Success, NY, USA

Abstract

Babesiosis is a tickborne disease caused by *Babesia microti*, an intracellular parasite of red blood cells. Presently, *B. microti* is the most common and deadly pathogen transmitted by blood transfusion. *B. microti* infects humans via *Ixodes scapularis* ticks, the same vector that carries *Borrelia burgdorferi*, the causative agent of Lyme disease. Co-infection with these two diseases increases the duration and severity of symptoms, posing a major therapeutic challenge. We aimed to determine the co-infection rate of *B. microti* in individuals who tested positive for Lyme disease in New York State. Of the 154 sera samples that were tested by immunofluorescence assay, 33 (21.4%) of the of the individuals who had Lyme disease and a current *B. burgdorferi* infection also tested positive for IgM and IgG antibodies against *B. microti*, suggesting recent co-infection with both TBDs. Additionally, of the individuals who previously had Lyme disease as indicated by IgG antibodies against *B. burgdorferi*, 4 (2.6%) tested positive for antibodies against *B. microti*. The results suggests co-infection of *B. microti* and Lyme disease is prevalent in New York, an area endemic for TBDs. Additionally, our findings agree with reports that *B. burgdorferi* may help facilitate the emergence of *B. microti*. Our data suggest the need for an extensive study investigating co-infection of *B. microti* and Lyme disease and further support the need for an FDA-approved screening test to help prevent transfusion-transmitted babesiosis.

Introduction

Human babesiosis is an emerging zoonotic TBD caused by protozoa of the genus Babesia, which are obligate intracellular parasites of red blood cells. *Babesia microti* is currently the number one pathogen that is transmitted by blood transfusion in the U.S. for which no FDA-approved donor screening is currently available. It is also responsible for the highest percentage (38%) of transfusion-related infectious fatalities reported to the FDA in transfusion recipients. *B. microti* and *B. burgdorferi*, the causative agents of human babesiosis and Lyme disease respectively, are known to be prevalent within the same geographical range. This is attributed to the fact that the same vector, the *Ixodes* scapularis tick, transmits both infections. *I. scapularis* ticks may be infected with either of these pathogens or both simultaneously. Some studies have suggested concurrent infection with *B. burgdorferi* has a synergistic effect on *B. microti*. Reported co-infection rates of *B. microti* with *B. burgdorferi* varies greatly with the focus often being on the co-infection of ticks and not humans. Moreover, it has been suggested that co-infection with these two diseases, promotes the development of more severe symptoms than seen in patients infected with the individual pathogen; which poses a major therapeutic challenge. In addition, each of these diseases are treated with different antibiotic regimens, specific to that parasitic disorder. If co-infection is not diagnosed in a patient, then only one of the diseases may be successfully treated, posing a risk to immunocompromised individuals undergoing blood transfusion.

Hypothesis

There is a higher co-infection rate of *B. microti* in individuals that test positive for *B. burgdorferi* than is currently being reported in New York State.

Table 1. Results table. Presence of Lyme disease was based on the detection of IgM (current infection) or IgG (past infection) antibodies or both by Western blotting. Individuals were considered IFA positive for *B. microti* if they tested positive for both IgM and IgG antibodies. Of the 154 samples tested, 0.7% of patients tested negative for Lyme disease and positive for *B. microti* while 21.4% of patients were positive for current Lyme disease and *B. microti* representing a significant increase for individuals with current co-infection (p>0.5). Of the individuals who previously had Lyme disease, 2.6% of patients were also positive for *B. microti*.

<table>
<thead>
<tr>
<th>Lyme Disease</th>
<th>IFA positive</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Current Infection</td>
<td>33</td>
<td>21.4</td>
</tr>
<tr>
<td>Past Infection</td>
<td>4</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Figure 1. Distribution of Reported Lyme and Lyme/Babesiosis Patients (Source: Trends in Pathology). Map of the United States indicating counties in which reported reported cases of Lyme disease and co-infection of Lyme and babesiosis, respectively. Counties with three or more cases of Lyme disease but fewer than three cases of babesiosis are depicted in green. Counties with three or more cases of Lyme disease and three or more cases of babesiosis are depicted in gray.

Figure 2. Sample population and demographics. A. Sample collection. Breakdown of the months in which samples (n=154) were collected. Samples were collected during summer months in which tickborne diseases are most prevalent. B. Gender distribution. Of the individuals tested, 58% were male, 40% were female and 2% were unknown. C. Age distribution. The median age of our sample population was 46.6 and our mean age was 52.

Figure 3. Indirect Immunofluorescence assay for *B. microti*. Immunofluorescence assay (IFA) was used for the detection of IgM and IgG classes of antibodies against *B. microti* in human sera.

Figure 4. Representative images of *B. microti* immunofluorescence assay. A. FITC-labeled anti-human IgM antibody. B. FITC-labeled anti-human IgG antibody. C. Anti-human IgM antibody, directed against *Babesia microti*. D. Anti-human IgG antibody, directed against *Babesia microti*.

Figure 5. GFP-labeled *B. microti* and *B. burgdorferi*, representing a significant increase for individuals with current co-infection (p>0.5). Of the individuals who previously had Lyme disease, 2.6% of patients were also positive for *B. microti*.

Conclusions

The aim of this study was to determine the co-infection rate of *B. microti* in individuals that tested positive for Lyme disease. Overall, the findings of our study suggest that additional testing for the prevalence of Babesia, in individuals suspected of or diagnosed with Lyme disease needs to be performed, particularly in areas where it is endemic. Moving forward, it would be useful to do a more extensive study with a larger sample size and well matched controls. The results presented in this study coincide with our hypothesis suggesting that there is a higher rate of co-infection than previously reported.

Acknowledgements

Thank you to Stephanie Epstein at Northwell Core Laboratories for assisting with this collaboration and providing serum samples. Thank you to the Department of Biomedical Sciences at LIU Post for providing support for this study.

References

(2) Blood Products Advisory Committee Meeting Report, 2015