Seroprevalence of *Babesia microti* in Individuals with Lyme Disease

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### Lyme Disease

- Most common vectorborne illness in the United States
- Caused by the tick-transmitted spirochete *Borrelia burgdorferi*
- Symptoms: Flu-like symptoms, erthyema migrans
- Complications: Chronic joint inflammation, neurological symptoms, cognitive defects, heart rhythm irregularities
Erythema Migrans

(Center for Disease Control and Prevention)
Lyme Disease Cases by Symptom

Source: CDC
Lyme Disease Transmittance

Source: CDC
Lyme Disease Transmittance

Source: CDC
Lyme Disease 2001 vs. 2014

300,000 cases of Lyme disease are reported to the U.S. Centers for Disease Control and Prevention (CDC)

Source: CDC
Lyme Serology

Source: Journal of The American Board of Family Medicine
Lyme Testing

Two-Tiered Testing for Lyme Disease

First Test
- Enzyme Immunoassay (EIA)
  OR
- Immunofluorescence Assay (IFA)

Positive or Equivocal Result
- Negative Result
  Consider alternative diagnosis
  OR
  If patient with signs/symptoms consistent with Lyme disease for ≤ 30 days, consider obtaining a convalescent serum

Second Test
- Signs or symptoms ≤ 30 days
  IgM and IgG Western Blot
- Signs or symptoms > 30 days
  IgG Western Blot ONLY

Source: CDC
Treatment for Lyme

- Doxycycline
  - Orally
  - Intravenous
Babesiosis

- Caused by *Babesia spp.*
  - *B. microti* in the U.S.
  - Notifiable in 2011
  - Transmitted by *Ixodes scapularis*

- 1,744 positive cases of babesiosis in 2014

- Symptoms: Malaria-like symptoms, chills, sweats, headache, arthralgia, myalgia, anorexia, and cough
  - Many patients are often asymptomatic

- Complications: Low and unstable blood pressure, hemolysis, thrombocytopenia, disseminated intravascular coagulation, malfunction of vital organs, and death
Life Cycle of *B. microti*

*Source: CDC*
Transfusion-Transmitted Babesiosis (T.T.B)

- *B. microti* is the highest-ranking pathogen transmitted by blood transfusion
  - No FDA-approved donor screening currently available

- Over 200 documented cases of transfusion-associated infections since 1980

- Highest percentage (38%) of transfusion-related infectious fatalities reported to the FDA in transfusion recipients
Babesia Cases 2011-2014

Source: CDC
Distribution of *Babesia* Cases

Source: CDC
### Babesia Cases by State 2011

<table>
<thead>
<tr>
<th>State/Area of residence</th>
<th>Cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>1</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Connecticut</td>
<td>74</td>
<td>(6.6)</td>
</tr>
<tr>
<td>Delaware</td>
<td>1</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Indiana</td>
<td>0</td>
<td>(0.0)</td>
</tr>
<tr>
<td>Maine</td>
<td>9</td>
<td>(0.8)</td>
</tr>
<tr>
<td>Maryland</td>
<td>4</td>
<td>(0.4)</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>208</td>
<td>(18.5)</td>
</tr>
<tr>
<td>Minnesota</td>
<td>73</td>
<td>(6.5)</td>
</tr>
<tr>
<td>Nebraska</td>
<td>0</td>
<td>(0.0)</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>13</td>
<td>(1.2)</td>
</tr>
<tr>
<td>New Jersey</td>
<td>166</td>
<td>(14.8)</td>
</tr>
<tr>
<td>New York** (New York City)</td>
<td>361</td>
<td>(32.1)</td>
</tr>
<tr>
<td>New York City</td>
<td>57</td>
<td>(5.1)</td>
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<tr>
<td>Oregon</td>
<td>1</td>
<td>(0.1)</td>
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<tr>
<td>Rhode Island</td>
<td>73</td>
<td>(6.5)</td>
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<tr>
<td>Tennessee</td>
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<tr>
<td>Vermont</td>
<td>2</td>
<td>(0.2)</td>
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<tr>
<td>Washington</td>
<td>0</td>
<td>(0.0)</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>80</td>
<td>(7.1)</td>
</tr>
</tbody>
</table>

**Total Cases:** 2185

14.8% 37.2%
Reported Cases by Age Group

Source: CDC
Reported Cases by Month

Source: CDC
Hospitalization data for babesiosis case-patients

Source: CDC
Detection of *Babesia*

**Laboratory supportive**
- *B. microti* by indirect fluorescent antibody (IFA) immunoglobulin (IgM or IgG) antibody

**Laboratory confirmatory**
- Intraerythrocytic *Babesia* organisms in a blood smear
- Detection of *Babesia* spp. genomic sequences by nucleic acid amplification (PCR) or by FISH
Blood Smear
Treatment for Babesiosis

- Atovaquone
- Azithromycin
The Prevalence of Zoonotic Tick-Borne Pathogens in *Ixodes Scapularis* Collected in the Hudson Valley, New York State


OPEN ACCESS Freely available online

Co-Infection of Blacklegged Ticks with *Babesia microti* and *Borrelia burgdorferi* Is Higher than Expected and Acquired from Small Mammal Hosts

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RESEARCH ARTICLE

*Borrelia burgdorferi* Promotes the Establishment of *Babesia microti* in the Northeastern United States

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Why is Co-Infection a Major Health Concern?

- *B. burgdorferi* contributes to the emergence and expansion of *B. microti*
- Promotes development of more severe symptoms
  - posing a major therapeutic challenge
  - Presentation is atypical of either disease
- *Babesia* is the most transmitted pathogen via blood donation
  - Important to determine rate of co-infection to ensure the safety of our blood supplies
- Treated with different antibiotics
  - Requires proper diagnosis to ensure clearance of both
Hypothesis

• Co-infection rate of *Babesia microti* is underreported.
  • Asymptomatic individuals, generalized symptoms, difficulty in diagnosis

• Individuals have a higher incidence of *Babesia microti* and *Borrelia burgdorferi* co-infection than has been reported, specifically in endemic areas

**Project aims:**
• Obtain samples of individuals tested for Lyme disease (NYS)
• Test them for the presence of *B. microti* by IFA to determine co-infection
• Analysis of results
Patient Samples

- Collaborated with Northwell Health
- 154 patient samples were provided
- Samples had patient identification removed in accordance to HIPAA regulations
  - Offline numbers were generated
  - No identifiable information was included, except demographics for analysis
Months of Sample Collection

Number of Samples

May | June | July | August | September
0   | 40   | 60   | 60     | 10
Sample Population

Curcio, et. al. (2016)  Vector Borne and Zoonotic Disease
Testing for Lyme Disease

- Chemiluminescence immunoassay to detect antibodies to VlsE protein

- All equivocal and positive results automatically reflexed to Lyme Western blot assay for IgM and IgG
VIsE Assay Results

Curcio, et. al. (2016) Vector Borne and Zoonotic Disease
Immunofluorescence (IFA) for *B. microti*

**Specificity:** 99%

**Sensitivity:** 91%
IFA for *B. microti*

<table>
<thead>
<tr>
<th>Negative Control</th>
<th>Positive Control</th>
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<tr>
<td>IgM 1:32</td>
<td>IgG 1:64</td>
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</table>

Curcio, et. al. (2016) Vector Borne and Zoonotic Disease
Babesia Results by IFA

Total=35

Curcio, et. al. (2016) Vector Borne and Zoonotic Disease
Limitations of our Study

- Lack of whole blood samples
- Use of immunofluorescence assay to determine infections rates
  - Analysis was subjective & difficult to determine
- Retrospective study
- Future studies
  - Perform PCR on samples to detect infection
Red Cross North-Central Study

- Tested blood donors samples in Minnesota
- 2,150 total samples were tested for Babesia
  - 42 donors were positive by IFA (2%)
- Minnesota represents only 6.5% of reported cases
- Implementation of an FDA-approved screen
Conclusions

• Results in this study agreed with our hypothesis suggesting higher rates of co-infection of *B. microti* and *B. burgdorferi* than previously reported.

• Further studies should be conducted for the prevalence of *Babesia*.

• Implementation of a FDA-approved screening test for *Babesia*.