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Short Communication

Human Babesiosis Caused by *Babesia odocoilei*: An Emerging Zoonosis

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Abstract

Human babesiosis caused by *Babesia odocoilei* has an innate ability to survive in humans. *Babesia odocoilei*, a sequestered *Babesia* sp. has unique survival mechanisms to occlude capillaries and venules by forming fibrin-bonded entanglements. Immune evasion has been mastered, and establishment of persistent infections promote survival. Because *B. odocoilei* sequesters, this tick-borne zoonosis is recalcitrant to treat.

Short Communication

An emerging tick-borne zoonotic disease called human babesiosis caused by *Babesia odocoilei* is widely distributed in North America. This piroplasmid, a single-celled, red blood cell parasite causes a multitude of insidious symptoms in humans. This microscopic hemoparasite is commonly transmitted by a *B. odocoilei*-infected *Ixodes* tick, but can be transmitted by blood transfusion, organ transplantation, and congenital transmission.

Tick vectors include the western blacklegged tick, *Ixodes pacificus* and the blacklegged tick, *Ixodes scapularis*. Mammalian reservoirs are primarily cervids (i.e., white-tailed deer, *Odocoileus virginianus*; black-tailed deer, *Odocoileus hemionus columbianus*), but desert bighorn sheep, *Ovis canadensis nelsoni*, also harbour *B. odocoilei* [1]. The first-ever discovery of *B. odocoilei* in humans was made by Scott et al. [2]. In Canada, *B. odocoilei* has been detected in three tick species (i.e., *Ixodes angustus, Ixodes pacificus*, and *Ixodes scapularis*) continent wide [3]. Scott and colleagues found that the ratio of *B. odocoilei* to *Babesia microti* in *I. scapularis* adults is 60 to 1 [3]. *Babesia odocoilei* is, undeniably, the predominant *Babesia* sp. across North America. Based on testing 224 *Ixodes* ticks, researchers found that people are just as likely to contract human babesiosis as Lyme disease [3]. In fact, the Canada-wide prevalence of *B. burgdorferi* and *B. odocoilei* in *I. scapularis* adults was 40% and 36%, respectively [3]. In B.C., a person is pathologically more likely to be bitten by a *B. odocoilei*-positive *Ixodes* tick than a *B. burgdorferi*-positive *Ixodes* tick [3,4].

Migratory songbirds play an integral role in the wide dispersal of *I. scapularis* larvae and nymphs. *Ixodes scapularis* harbour at least six tick-borne zoonotic pathogens that infect humans [4]. In the spring, northward-bound songbirds transport ticks into Canada from as far south as the neotropics and, alternatively, in the fall, southward-migrating songbirds transport ticks to southern latitudes. In Canada, the predominant pathogens that are transmitted to humans are *B. burgdorferi* and *B. odocoilei* [3]. Based on a tick-host-pathogen study, researchers detected five tick-borne zoonotic pathogens in the blood of songbirds [5]. As well, five pathogens have been detected in several studies [3,6]. *Babesia odocoilei* and *B. burgdorferi* were the most prominent pathogens [6]. When walking in forest and grassy habitat, it is just as likely for a juvenile *I. scapularis* to be infected with *B. odocoilei* (human babesiosis) as *B. burgdorferi* (Lyme disease) [3].

When a *B. odocoilei*-infected *I. scapularis* takes a blood meal, it spews sporozoites into the blood stream, and they quickly circulated throughout the body. Fibrinogen in the

blood converts to fibrin, and adheres to the tubular endothelium (cytoadhesion), and clogs in capillaries and post-capillary venules (sequestration) [7,8]. Pathologically fibrin encompasses both infected Red Blood Cells (iRBCs) and uninfected Red Blood Cells (uRBCs) [7,8]. These 3 components form fibrin-bonded entanglements that block capillaries and venules, especially in the brain that have the smallest capillaries. Sequestering *Babesia* species (i.e., *B. bovis, B. canis, B. odocoilei*) can complete their life cycle within fibrin-bonded entanglements and, thus, trophozoites and merozoites remains isolated from the circulatory immune system and spleen [9]. Immune evasion is ostensible. For babesial survival, iRBCs, iRBCs and fibrin form occlusions, and self-perpetuate life within these entanglements. As cytoadhesion progresses and sequestration builds (using mature babesial stages) [7], *B. odocoilei* has an exceptional means to avoid splenic clearance [9]. In contrast, non-sequestering *Babesia* (i.e., *B. microti*) allow the immune system, which consist of microphages, to function normally, and the spleen typically traps and destroys babesial merozoites. Subsequently, patients with *B. microti* are normally much easier to treat successfully.

Common Symptoms

Because fibrin-bonded entanglements occlude capillaries and venules, oxygen and nutrient are greatly reduced. As *B. odocoilei* propagates, a multitude of symptoms develop, including unyielding fatigue, cognitive impairment, perpetual inflammation (especially in legs at night), restless legs, brain fog, anxiety, delirium/disorientation, nightmares, profound wild dreams, disorientation, difficulty remembering, progressive dementia, dizziness, memory loss, muscle and joint stiffness, muscle and joint aches, clumsiness, poor balance, unsteady gait, bladder disfunction, intestinal problems, constipation, sleep disturbance, insomnia, sweats (especially at night), irritability/rage/aggression, irritability, ischemia (slow blood flow), chills, heat and cold intolerance, pathogen-induced depression, air hunger, longstanding headaches, encephalopathy, and Jarisch-Herxheimer reaction (herxing). Of particular note, human babesiosis caused by *B. odocoilei* inflict major depression in the population. A comorbidity, such as human babesiosis caused by *B. odocoilei* and Lyme disease caused by *B. burgdorferi* s.l. can cause pain and suffering.

As *B. odocoilei* advances, patients show severe clinical signs and symptoms. Patients can become bedridden and disabled as manifestations progress. As these symptoms develop, patients can be suicidal/homicidal and, in some cases, can have fatal outcomes [3]. As fibrin-bonded entanglements of *B. odocoilei* occlude capillaries and venules, children often become non-verbal, develop muscle weakness, and have unsteady gait. Moreover, children often have bladder and bowel dysfunctional. In particular, *B. odocoilei* is a sequestering *Babesia* that is recalcitrant to treat [3]. In contrast, *B. microti*, is a non-sequestering *Babesia* sp. that is typically less difficult to treat. However, *B. odocoilei* has developed highly effective mechanism for parasite survival in humans. Deer culls are needed to reduce human babesiosis caused by *B. odocoilei*. Tick repellants are efficacious. Since people spend considerable time in the outdoors, healthcare professionals must acquire continuing medical education in tick-borne zoonotic diseases.

Acknowledgement

None.

Conflict of Interest

None.

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