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Temt rozprawy:
Co-occurrence of *Babesia* spp. (Apicomplexa: Piroplasmida) and *Borrelia* spp. (Bacteria: Spirochaetes) in common ticks, *Ixodes ricinus*, in urban areas on the example of Poznań.

Streszczenie rozprawy doktorskiej w języku angielskim

Ixodes ricinus, the vector of tick-borne pathogens (TBPs), is the most epidemiologically important tick in Europe. Comprehensive knowledge of enzootic circulation cycles of TBPs transmitted by *I. ricinus* in urban ecosystems is still lacking. Due to the dense population of humans, companion animals, and natural tick hosts, those environments provide unique conditions for tick-borne zoonotic infections to occur. In addition to spirochetes from the *Borrelia burgdorferi* s.l. complex, which are the cause of Lyme borreliosis (LB), *I. ricinus* ticks are involved in the transmission of *B. miyamotoi*—a spirochete from the relapsing fever group (RF), the causative agent of *B. miyamotoi* disease. Some TBPs may occur as coinfections in ticks and reservoir hosts, indicating the likelihood of their simultaneous transmission to humans or domestic animals. It has been demonstrated that coinfections with *B. burgdorferi* s.l. and *Babesia microti* protists in ticks and small rodents can locally intensify the expansion of *Ba. microti*. In Europe, three species—*Ba. microti*, *Ba. divergens*, and *Ba. venatorum*—can cause human babesiosis, posing a threat to immunocompromised patients. In the case of such dual infections, the course of the disease may be more severe, with persisting symptoms. Furthermore, *Ba. canis* is the sole species responsible for canine babesiosis in Poland; its competent vector is the meadow tick, *Dermacentor reticulatus*. This dissertation aimed to analyze the occurrence of *Borrelia* spp. bacteria and *Babesia* spp. protists, with an assessment of the frequency of their coexistence (coinfections) within urban populations of *I. ricinus* ticks, using the city of Poznań as an example.

The research material comprised host-seeking ticks (i.e., from vegetation) collected from five recreational areas in Poznań (n=1059) along with specimens obtained from companion animals (dogs and cats) in collaboration with 17 veterinary clinics in Poznań (n=1268 females). TBPs detection was performed by sequencing DNA marker fragments.

The presence of *B. burgdorferi* s.l. DNA was confirmed in 8.7% (90/1029) of host-seeking ticks, including 11.8% of females (34/289), 9.6% of males (27/280), and 6.3% of nymphs (29/460). A nearly two times lower infection rate (4.7%) was detected in females collected from animals. In both groups of ticks, species belonging to the spirochetes causing LB were identified: *B. afzelii*, *B. garinii*, *B. lusitaniae*, *B. valaisiana*, and among ticks collected from dogs, additionally, *B. spielmanii*. The presence of *B. miyamotoi* DNA, a species representing the *Borrelia* RF group, was detected in 2.1% of hosts-seeking ticks and 1.8% of ticks collected from dogs and cats.

The presence of *Babesia* spp. protists was detected in 4.4% of ticks collected from vegetation, including 7.3% of females, 4.6% of males, and 2.4% of nymphs. *Babesia* spp. DNA was also identified in 6% of female *I. ricinus* ticks feeding on companion animals. In both groups of ticks, two species potentially pathogenic to humans were identified: *Ba. microti* and *Ba. venatorum*, along with *Ba. canis*. Among the infections, *Ba. canis* (61.2%) and *Ba. microti* (34.7%) prevailed. In total, the co-occurrence of infections with *Borrelia* spp. and *Babesia* spp. was noted in 1% (24/2297) of ticks. Among the infected ticks collected from vegetation, *Ba. canis* predominated in coinfections (72.7%; 8/11), occurring alongside *B. afzelii* or *B. garinii*. In ticks from animals, *Ba. microti* prevailed (92.3%; 12/13), mainly with *B. afzelii*.

In summary, the clear dominance of *Ba. canis* suggests the functioning of *I. ricinus* as a vector in enzootic cycles in the central-western regions of Poland, where *Dermacentor reticulatus* is absent or rare. Under these circumstances, dogs in urban areas may face a potential risk of contracting babesiosis. Observing the dominance of two pathogenic spirochete species, *B. afzelii* and *B. garinii*, and detecting sequences that correspond to the strains causing babesiosis in humans (*Ba. microti* and *Ba. venatorum*) in both tick groups, points to the risk of acquiring LB and/or babesiosis by people using urban green areas. Moreover, the presence of *B. miyamotoi* infections makes it possible to contract *B. miyamotoi* disease, which should be considered in differential diagnosis. The coexistence of potentially pathogenic species from the *Borrelia* and *Babesia* genera within urban tick populations may modify clinical symptoms, the course, and severity of diseases caused by the pathogens. Therefore, in the examination of humans and dogs with presenting fever symptoms after tick exposure, physicians and diagnosticians should carefully consider the possibility of coinfections.

Keywords: *Ixodes ricinus*, *Babesia*, *Borrelia* LB, Lyme borreliosis, *Borrelia* RF, *B. miyamotoi* disease, babesiosis, tick-borne pathogens, coinfections.