

ИНФЕКЦИОННЫЕ БОЛЕЗНИ INFECTIOUS DISEASES

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IXODID TICKS AND TICK-BORNE INFECTIONS IN THE REPUBLIC OF CUBA – LITERATURE REVIEW AND RATIONALE FOR RISK ASSESSMENT

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The Republic of Cuba is a popular destination for Russian tourists and about 30-50 thousands of Russian citizens visit Cuba annually. However, the recreational activity is often associated with the risk of Ixodid ticks bites and infection with tick-borne pathogens. According to published literature, the fauna of the hard tick in Cuba is represented by nine species including *Ixodes capromydis*, *Amblyomma albopictum*, *A. cajennense*, *A. dissimile*, *A. quadricavum*, *A. torrei*, *Dermacentor nitens*, *Rhipicephalus sanguineus* and *R. (Boophilus) microplus*. Five of these species, i.e. *A. cajennense*, *A. dissimile*, *D. nitens*, *R. sanguineus* and *R. (Boophilus) microplus*, were reported as human parasites. Ticks are spread over the most part of the island territory. Several tick-borne pathogens should be considered as a potential threat for the bitten humans in Cuba, including *Borrelia burgdorferi sensu lato*, *Rickettsia sp.*, *Anaplasma sp.*, *Ehrlichia sp.*, *Coxiella sp.*, thogotovirus and Crimean-Congo hemorrhagic fever virus. Implications for the epidemiology of tick-borne infections in the Russian Federation are discussed.

Key words: ticks, Ixodidae, Cuba, Russia, tick-borne infections

ИКСОДОВЫЕ КЛЕЩИ И ПЕРЕДАВАЕМЫЕ ИНФЕКЦИИ В РЕСПУБЛИКЕ КУБА – ОБЗОР ЛИТЕРАТУРЫ И ОБОСНОВАНИЕ ДЛЯ ОЦЕНКИ РИСКА ЗАРАЖЕНИЯ

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С каждым годом растёт привлекательность Республики Куба в качестве места отдыха граждан Российской Федерации. Ежегодно эту страну посещают с туристическими целями порядка 30–50 тысяч наших соотечественников. Однако отдых на природе зачастую связан с риском укусов иксодовых клещей и заражения передаваемыми ими инфекциями. Согласно опубликованным к настоящему моменту данным, на территории Кубы обитают девять видов иксодовых клещей, включая *Ixodes capromydis*, *Amblyomma albopictum*, *A. cajennense*, *A. dissimile*, *A. quadricavum*, *A. torrei*, *Dermacentor nitens*, *Rhipicephalus sanguineus* и *R. (Boophilus) microplus*. Пять из этих видов, а именно *A. cajennense*, *A. dissimile*, *D. nitens*, *R. sanguineus* и *R. (Boophilus) microplus*, были отмечены в качестве паразитов человека. Клещи распространены на большей части территории острова. Несколько патогенов, передающихся при укусах клещей, следует рассматривать в качестве возможной угрозы для здоровья людей, пострадавших от укуса клеща на Кубе. Это, прежде всего, *Borrelia burgdorferi sensu lato*, *Rickettsia sp.*, *Anaplasma sp.*, *Ehrlichia sp.*, *Coxiella sp.*, вирус Тогото и вирус Крымской-Конго геморрагической лихорадки. В работе обсуждаются возможные последствия для эпидемиологии клещевых инфекций в Российской Федерации.

Ключевые слова: иксодовые клещи, Ixodidae, Куба, Россия, клещевые инфекции

In the modern world, the international journeys are a significant part of the global economy. Millions of people travel worldwide annually. In recent years, it became usual for tourists from the Russian Federation to travel to remote countries with a warm tropical and subtropical climate. However, the recreational activity is often associated with a risk of infection with

vector-borne pathogens. Ixodid ticks that are very important disease vectors can bite both locals and travelers. Thus, according to our observations, up to 10 residents of the Irkutsk Region get a tick bite while traveling abroad annually. Tick bites were reported in 18 countries including such remote ones as Thailand, Japan, United Kingdom and USA [6].

The Republic of Cuba is included in the top 50 countries that are visited by tourists from the Russian Federation. Thus, according to the Federal Agency for Tourism of Russian Federation (Russiatourism), 44 951 Russian citizens visited Cuba in 2016. The annual increase of tourist exchange between Cuba and Russia over last 3 years reached 129 % [32]. Recently, a case of tick bite was reported by a Russian tourist while visiting historical site suburbs of Havana (L.V. Rychkova, personal communication).

The aim of this review is to summarize briefly the published information about the fauna of ixodid ticks in the Republic of Cuba and evaluate its implications for epidemiology of tick-borne diseases in Russia. The publications were selected from the PubMed database (<https://www.ncbi.nlm.nih.gov/pubmed>) using key phrases "tick+Cuba", "Ixod+Cuba", "Dermacentor+Cuba", "Haemaphysalis+Cuba", "Amblyomma+Cuba", "Tick-borne+Cuba", "Borrelia+Cuba", and "Anaplasma+cuba". The results were manually filtered according to the relevance. Taxonomy of *Ixodidae* family is used according to Filippova, 1997 [12].

FAUNA AND DISTRIBUTION OF TICKS IN CUBA

The fauna of the hard tick in Cuba is represented by nine species belonging to genera *Ixodes*, *Amblyomma*, *Dermacentor* and *Rhipicephalus*. The only representative of *Ixodinae* subfamily is the Cuban endemic *Ixodes capromydis*. The subfamily *Amblyomminae* is presented by five *Amblyomma* (*A. albopictum*, *A. cajennense*, *A. dissimile*, *A. quadricavum*, *A. torrei*), one *Dermacentor* (*D. nitens*), and two *Rhipicephalus* species (*R. sanguineus* and *R. (Boophilus) microplus*) [2].

A. albopictum Neumann, 1899 is associated with reptiles (snakes and lizards) as primary hosts. These ticks are spread over the Central America and inhabit tropical and subtropical dry broadleaf forests, deserts and xeric shrublands [17]. In Cuba, these ticks were detected in the Province of La Havana, Camaguey, Doce Leguas Cayos, Isle of Pines, and Isla De La Juventud [2, 36]. The ecology of these highly specialized ticks is not so far described completely, and no attacks on humans reported for *A. albopictum*.

A. cajennense (Fabricius, 1787) is widespread over Nearctic and Neotropical regions from the United States on the North to Argentina on the South. This tick has adapted to widely different ecological conditions, including ecosystems as different as semi-arid grasslands and subtropical secondary forests. *A. cajennense* prefers mild tropical climate with the mean annual temperature above 16-17 °C and does not appear to have been collected north of 27° N or south of 29° S [10]. In Cuba, it has been reported in Provinces of Havana, Pinar del Rio, and Villa Clara [36] as well as from Provinces of Santiago de Cuba, Camaguey, and Isla De La Juventud [2]. These ticks parasitize over a broad range of mammalian and avian hosts, with reptiles and anura reported as exceptional hosts. Several species of birds belonging to orders Ciconiiformes, Falconiformes, Struthioniformes, Cuculiformes, Galliformes, Passeriformes and Columbiformes were reported as hosts for *A. cajennense* [17]. Adult ticks feed on equids, cattle, dogs, wild carnivores (Canidae and Procionidae) and ungulates (Tapiridae, Tayassuidae and Cervidae). Immature stages feed on numerous rodent species, wild carnivores and ungulates [10]. *A. cajennense*

is a frequent parasite of humans in Neotropical regions. Numerous human bites are reported from such countries as Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Suriname and Venezuela [15].

A. dissimile Koch, 1844 is widespread over the Neotropical and Neoarctic and inhabits tropical and subtropical dry broadleaf forests, grasslands, savannas and shrublands [17]. Primary hosts for *A. dissimile* are Squamata (63 species) and Anura (4 species). Mammals, birds and crocodiles are exceptional hosts [16]. The transport of *A. dissimile* to the boreal ecosystems of Canada with migrating passerine birds (veery, *Catharus fuscescens*) has been recently documented [34]. These ticks are well known parasites of humans [15, 16].

A. quadricavum (Schulze, 1941) is a Neotropical tick inhabiting tropical and subtropical moist broadleaf forests. Usual hosts for these ticks are boas, iguanas and vipers [17]. Curiously, five specimens of *A. quadricavum* were accidentally introduced into Poland with pet lizards (*Iguana iguana*) imported from El Salvador [27]. No cases of human infestation have been registered for *A. quadricavum* so far.

A. torrei Perez Viguera, 1934 are parasites of Squamata (lizards and iguanas mostly). The Anura may serve as exceptional hosts for *A. torrei*. These ticks inhabit tropical and subtropical moist broadleaf forests and mangroves and distributed in provinces of Camaguey, La Habana, Playa De Jaimanitas, Guanahacabibes, and Pinar Del Rio [2, 36]. No human infestation has been reported.

D. nitens Neumann, 1897, or tropical horse tick, is widespread in neotropical ecosystems. It is widely distributed over the entire island and it has been reported in Provinces of Havana, Pinar del Rio, Santa Clara, Matanzas, and Camaguey [36]. *D. nitens* is one-host ticks with equines serving as the primary host. However, many other domestic and wild animals, including bovines, ovines, felines and rabbits, can serve as alternative hosts [discussed in: 29]. Snakes and toads are also reported as exceptional hosts for *D. nitens* [17]. A number of cases of *D. nitens* feeding on human host were registered in Bolivia, Brazil and Colombia [15].

I. capromydis Černý, 1966 is Cuban endemic and reported only from Guaya canal (Juventud Island, Cuba). Main habitation for this ticks are Cuban pine forests [3]. *I. capromydis* is associated with a specific mammalian host *Capromys pilorides* (Rodentia: Capromyidae) or Cuban hutia. These large rodents are widely distributed not only on the Juventud Island, but also on the Cuban mainland and many other islands of the Cuban archipelago [38]. The populations of hutia are numerous and the density may reach 50 animals per hectare [1]. Cuban hutia is reported to be the object of hunting and keeping in captivity as a livestock [28]. There have been no reports of feeding of *I. capromydis* on humans so far.

R. microplus (Canestrini, 1887) is a cosmopolitan species inhabiting many ecoregions in tropical and sub-tropical areas worldwide. Bovidae serve as main hosts for *R. microplus*, whereas birds and reptiles are registered as exceptional hosts [17]. In Cuba, these ticks are spread in the provinces of San Juan y Martínez, Santiago De Las Vegas, Pinar Del Rio, Bayamo, Guane, Isla De La Juventud, and Santiago De Cuba [2]. Numerous cases of human infestation are documented in many countries of South America [15].

R. sanguineus (Latreille, 1806) inhabits both Old and New Worlds. In Cuba, the species has been found in the provinces of La Habana, Camague, San Juan y Martínez, Isle of Pines, Santiago de Las Vegas, and Pinar del Rio [2]. These ticks are considered as a group of closely related groups with yet unresolved taxonomic status and are proposed to be designated as *R. sanguineus sensu lato* [8]. Ticks identified as *R. sanguineus s.l.* were exclusively found on dogs, however occasionally, *R. sanguineus* can infest a wide range of domestic and wild hosts, including cats, rodents and birds. [7, 8]. *R. sanguineus* is a recognized parasite biting humans both at imago and nymphal stages and is able to infest densely populated urban areas [15, 35]

TICK-BORNE INFECTIONS

To date, several tick-borne infections of humans and domestic animals were shown to circulate in the Cuban ecosystems. The agents of human granulocytic anaplasmosis (HGA), *Anaplasma spp.*, were detected in *R. sanguineus* [31]. Besides this, the antibodies against Lyme disease (LD) agent *Borrelia burgdorferi sensu lato* [30], *Babesia bovis* and *B. bigemina* [35] were detected in the blood of the local residents. The *Anaplasma marginale* that is a significant cattle pathogen was isolated both in western and in eastern parts of the country [4]. Authors emphasize that ixodid ticks pose the serious threat for human health and stock rising in developing countries [31]. Recently, it has been shown that *D. nitens* ticks can harbour the *Borrelia burgdorferi sensu stricto* [13], that suggest the vector capacity of these ticks for Lyme disease in Cuba. *A. cajanense* was demonstrated as a biological vector for *Theileria (Babesia) equi* – an important haemoparasite of equines [33]. *R. sanguineus* have been regarded as a vector for a number of pathogenic microorganisms, including significant human pathogens such as Crimean-Congo hemorrhagic fever virus (CCHFV), Thogotovirus Thogoto (THOV), *Coxiella burnetii* (agent of Q-fever), *E. canis*, *E. chaffeensis*, *R. conorii* (agent of Mediterranean spotted fever), *R. massiliae* (agent of spotted-fever) and *R. rickettsii* (agent of Rocky Mountain spotted fever) [7, 19, 20]. *R. microplus* can transmit the *Babesia spp.* and *Anaplasma marginale*, agents that can cause a severe disease in cattle and often have major impacts on livestock production [2].

IMPLICATIONS FOR EPIDEMIOLOGY OF TICK-BORNE INFECTIONS IN RUSSIA

The official registration indicates about 15 000 reported tick bites annually in the Irkutsk region. There are six species of ixodid ticks inhabiting the Pribaikalye region – *Ixodes persulcatus* Schulze, 1930; *I. lividus* Koch, 1844; *I. trianguliceps* Birula, 1895; *Dermacentor nuttalli* Olenov, 1929; *D. silvarum* Olenov, 1932 and *Haemaphysalis concinna* Koch, 1844. Besides this the rare occasional findings of *I. subterraneus* Filippova, 1961, *I. crenulatus* Koch, 1844, *I. berlesei* Birula, 1895, и *I. stromi* Filippova, 1957 were reported from the Eastern Siberia and neighbor territories [5, 11, 23, 24, 25]. To reduce the risk of human infection, the technology of urgent detection and prevention of tick-borne diseases was developed and implemented at the Federal Budgetary Scientific Center for Family Health and Human Reproduction Problems (FBSC FHHRP) in Irkutsk. Each tick is routinely tested for

infection with TBEV, *B. burgdorferi sensu lato*, *A. phagocytophilum* and *E. muris/E. chaffeensis*. In case when any pathogen is detected in the tick, the patient receives the treatment with anti-TBEV immunoglobulins and/or antibiotics to prevent the disease according to modern Russian healthcare regulations. However, the analyzed literature data indicate that people bitten by the Cuban ticks can be infected with other pathogens, those will be not detected by the currently used tests. Thus, in case when residents of Russia report a tick bite while being in Cuba, the infection with *Rickettsia sp.*, *Anaplasma sp.*, *Coxiella sp.*, THOV, CCHFV should be considered as possible in addition to usual tick-borne pathogens.

Besides this, during the last decade several people were attacked by ticks that are exotic for the Eastern Siberia. In 2008, we revealed the unique case of sucking of *Amblyomma americanum* in the suburban area of Irkutsk city. Epidemiological investigation excluded the import of tick from abroad either by the bitten patient or by domestic pets. It was revealed that the causative tick was indeed molted and questing in the Siberian ecosystem [22, 26]. In 2013 and 2014, there were local cases of tick bites caused by *Rhipicephalus sanguineus* Latreille, 1806. The detailed study confirmed the local origin of all these exotic ticks and revealed the existence of at least three independent migration routes of *A. americanum* and *R. sanguineus* into the Eastern Siberia from genetically divergent populations. All these ticks were able to migrate several thousands kilometers from their convenient ecosystems and survive at least for some time in continental climate [22]. It can not be excluded that exotic ticks may migrate from Cuba as well and any inconvenient tick need to be carefully studied to identify its species.

CONCLUSION

Published data clearly demonstrate that there could be a significant risk of tick attacks on human population in Cuban ecosystems and tourists from Russia definitely share this risk. Indeed, there are numerous species of hard ticks inhabiting various biotopes, including urban and suburban areas and, probably, places of historical and recreational interest. However, in spite of the significant advance in current research, the information on tick and tick-borne infections in Cuba is still incomplete. Thus, the data on modern geographical distribution, population density and structure and ecological characteristics of Cuban Ixodid ticks are very limited. For example, the spatial distribution and abundance of endemic tick *I. capromydis* was described for the last time about 50 years ago [3]. There are no data available on attack rate of ticks on human hosts and the associated risk of tick-borne infections. The Lyme disease is still not confirmed for Cuba and no data about clinical cases of this disease are published [9], though there are serological findings that indicate the presence of this pathogen in Cuban ecosystems. The diversity and prevalence of tick-borne pathogens in Cuban ticks are also not fully described. Even for confirmed microorganisms like *A. marginale*, *B. bovis* and *B. bigemina* the additional studies are recommended [34]. All this information is critical to evaluate the threat of the tick for human health. Thus, extended ecological and epidemiological research will improve our knowledge

about tick-borne infections in Cuba and will provide the proper urgent diagnostics and prevention of tick-borne diseases in the bitten humans. Such research will also be a significant contribution to further improvement of the healthcare in the Republic of Cuba.

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