

RESULTS REGARDING SEASONAL ACTIVITY, TEMPERATURE CONDITIONS OF THE EXISTENCE OF IXODUS TICKS AND THEIR ROLE AS TRANSMITTERS OF LYME DISEASE

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SUMMARY. Over the last 10 years, some countries in Europe have been troubled by the spread of infectious agents that are transmitted by ixodes ticks. Lyme disease is the most frequent ixodes tick-borne human disease in the world, with an estimated 85.500 patients annually.

The aim – to analyze the relationships between Lyme disease appearance and Ixodes tick bites number, air temperature, and their role in the transmission of Lyme disease.

Material and Methods. 798 ticks of *Ixodes Ricinus* were investigated. All ticks of the first type were found mainly in the city of Ternopil and Ternopil region, as well as some ticks were brought from Lviv, Ivano-Frankivsk and Rivne regions. The study was carried out using optical and electronic system SEO-IMAGLAB. Investigation of epidemiological state was carried out using the polymerase chain reaction (PCR) using amplifier method "ROTOR Gene-6000" in real time.

Results. Our studies showed, that about 30 % of ticks removed from humans are carriers of pathogens. Females of ticks are more carriers of *Borrelia Burgdorferi*, and the nymphs are carriers of *Anaplasma phagocytophilum* and *Borrelia Miyamotoi*. Larvae can be human ectoparasites and tolerate all three pathogens of infectious diseases. Including a complex carrying, that is the simultaneous transfer of pathogens of the two diseases. Taking into consideration the dynamics of the frequency of infection with ticks of *Ixodes ricinus*, were observed an increase number of females and nymphs that are carriers of pathogens in the period of May-July, and then, decrease the frequency of their infection in August-October. Obviously, the main cause of these fluctuations is the temperature regime, which changes in the spring-summer-autumn periods. Thus, the average temperature in May-June was 18–23 °C, in July-August – 25–27°C, in September-October – 20–15°C. At a temperature of 10–12°C, the number of patients affected by ticks decreased. As a result of studies on the influence of seasonal changes on the degree of infection with ticks of *Ixodes ricinus* by pathogens of infectious diseases, it's direct dependence on the temperature regime: at a temperature of about 18–15°C, the degree of infection in the nymph is 14%, and in females – 22 %, while at 25–28°C in the nymph this figure is 37 %, and in females – 72 %.

Conclusions. Geographic and seasonal distribution of Lyme borreliosis, patient's age, sex, and profession has disease-related effects on incidence.

KEY WORDS: ixodes ticks; Lyme disease; nymphs; larvae; pathogens.

Introduction. Over the last 10 years, some countries in Europe have been troubled by the spread of infectious agents that are transmitted by ixodic mites [1, 2]. Examples of the diseases are Lyme borreliosis, anaplasmosis, ehrlichiosis, babesiosis and some others.

Lyme disease (Borreliosis) is the most frequent ixodes tick-borne human disease in the world, with an estimated 85,500 patients annually (Europe 65.500, North America 16.500, Asia 3.500, North Africa 10) [3, 4].

The main reasons for this situation may be global warming, reduction of natural habitats, where up to now the circulation of these pathogens with little involvement in this process of humans, the increase in the number of rodents, birds and pets in cultivated agrobiocenosis and, first of all, in urbanized ecosystems.

Studies of Polish, Czech, Swedish, German, Slovak and other scientists show that most people are infected with infectious diseases by tick bites in artificial plantations, recreational areas, forest strips and other habitats of frequently visited people and in places, where are a lot of rodents, birds, cats, dogs, hedgehogs [1, 5].

The aim of the study – to find relationships between tick bites number and human age, place of leaving, frequency of being in forest, park and village as well as to find the most common places of tick bites on human body among the population of Ukraine. The work was also to establish the dependence between number of tick bites and the incidence of Lyme disease, to find the most common symptoms developed after tick bite, the most common laboratory tests used to diagnose the illness and its frequency of usage and to check, how often the prophylactic treatment is applied by doctors after tick bites.

Material and Methods. 798 ticks of *Ixodes Ricinus* were investigated. All ticks of the first type were found mainly in the city of Ternopil and Ternopil region, as well as some ticks were brought from Lviv, Ivano-Frankivsk and Rivne regions. The study was carried out using optical and electronic system SEO-IMAGLAB. Investigation of epidemiological state was carried out using the polymerase chain reaction (PCR) using amplifier method "ROTOR Gene-6000" in real time.

Results and Discussion. The town Ternopil (Ukraine) is characterized by a large number of green

spaces: parks, squares, recreational areas, forest strips and more. The relatively humid climate temperate provides optimal conditions for the development of different stages of ticks' development at different hosts. In this case, Ternopil and the Ternopil region are at increased risk of spreading infectious diseases caused by tick's pathogens.

Our studies showed, that about 30 % of ticks removed from humans are carriers of pathogens. Females of ticks are more carriers of *Borrelia Burgdorferi*, and the nymphs are carriers of *Anaplasma phagocytophilum* and *Borrelia Miyamotoi*. Larvae can be human ectoparasites and tolerate all three pathogens of infectious diseases. Including a complex carrying, that is the simultaneous transfer of pathogens of the two diseases.

In ticks of *Ixodes Ricinus*, human ectoparasites are not only. Adult ticks, but also nymphs and even larvae (the ratio of taken off nymphs and adult females from children is 2:1). Among the males, the carries were found of *Borrelia Burgdorferi sensu lato spirochete*. As we see from the general results of females, nymphs and larvae of *Ixodes ricinus* take an active part in the transfer of all three pathogens of infectious diseases. Including a complex carrying, that is the simultaneous transfer of pathogens of two diseases.

Taking into consideration the dynamics of the frequency of infection with ticks of *Ixodes ricinus*, we observed an increase the number of females and nymphs that are carries of pathogens in the period of May-July, and then, decrease the frequency of their infection in August-October. Obviously, the

main cause of these fluctuations is the temperature regime, which changes in the spring-summer-autumn periods. Thus, the average temperature in May-June was 18–23°C, in July-August – 25–27°C, in September-October – 20–15°C. At a temperature of 10–12°C, the number of patients affected by ticks decreased. As a result of studies on the influence of seasonal changes on the degree of infection with ticks of *Ixodes ricinus* by pathogens of infectious diseases, it's direct dependence on the temperature regime: at a temperature of about 18–15°C, the degree of infection in the nymph is 14 %, and in females – 22 %, while at 25–28°C in the nymph this figure is 37 %, and in females – 72 %.

Most tick-affected populations have been attacked, in fact, in urban recreational areas.

The creation and use of interactive maps based on Medical Geoinformation System was an important part of scientific research [6]. All information about the morphology of the ticks, nymphs and imago stages, tick-borne infections. In the region was collected, stored, accumulated, analyzed and displayed, Information on the spread of ticks in selected is an incentive for local governments to apply chemical or biological control to limit the numbers of their intermediate hosts (rodents, street cats, dogs, etc.). It will create favorable conditions for the recreation of people and increase the level of environmental awareness of the population by informing them.

Conclusion. Geographic and seasonal distribution of Lyme borreliosis, patient's age, sex, and profession has disease-related effects on incidence.

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РЕЗУЛЬТАТИ ДОСЛІДЖЕННЯ СЕЗОННОЇ АКТИВНОСТІ, ТЕМПЕРАТУРНИХ УМОВ ІСНУВАННЯ ІКСОДОВИХ КЛІЩІВ, А ТАКОЖ ЇХ РОЛЬ ЯК ПЕРЕНОСНИКІВ ХВОРОБИ ЛАЙМА

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РЕЗЮМЕ. За останні 10 років деякі країни Європи стурбовані поширенням інфекційних агентів, переносниками яких є іксодові кліщі. Хвороба Лайма – це найпоширеніша хвороба людини, що передається іксодовими кліщами, у світі, приблизно це становить 85 500 пацієнтів щорічно.

Мета – проаналізувати сезонну активність, температурні умови існування іксодових кліщів, а також визначити збудників, які переносяться їх життєвими формами.

Матеріал і методи. Досліджено 798 кліщів *Ixodes Ricinus*. Усі кліщі зібрані переважно в м. Тернопіль та Тернопільській області, а також частина кліщів привезена із Львівської, Івано-Франківської та Рівненської областей. Дослідження проводили за допомогою оптико-електронної системи SEO-IMAGLAB. Дослідження епідеміологічного стану проводили методом полімеразної ланцюгової реакції (ПЛР) з використанням ампліфікаційного методу «ROTOR Gene-6000» у режимі реального часу.

Результати. Наші дослідження показали, що близько 30 % кліщів, вилучених з людей, є носіями патогенів. Носіями *Borrelia Burgdorferi* є частіше самки кліщів, а *Anaplasma phagocytophilum* і *Borrelia Miyamotoi* – німфи. Личинки можуть бути ектопаразитами людини і переносити всі три збудники інфекційних захворювань. У тому числі можливе комплексне носійство, тобто одночасне перенесення збудників двох захворювань. Ураховуючи динаміку частоти інфікування кліщами *Ixodes ricinus*, спостерігалось збільшення чисельності самок і німф, які є носіями збудників у травні-липні, а потім зменшення частоти їх інфікування у серпні-липні та жовтні. Очевидно, основною причиною цих коливань є температурний режим, який змінюється у весняно-літньо-осінній період. Так, середня температура травня-червня становила 18–23 °С, липня-серпня – 25–27 °С, вересня-жовтня – 20–15 °С. При температурі 10–12 °С кількість хворих, які зазнали укусів кліщів, зменшувалась. У результаті досліджень впливу сезонних змін на ступінь зараженості кліщів *Ixodes ricinus* збудниками інфекційних хвороб встановлено пряму залежність від температурного режиму: при температурі близько 18–15°C ступінь зараження у німфи становить 14 %, а у самок – 22 %, тоді як при 25–28 °С у німф цей показник становить 37 %, а у самок – 72 %.

Висновки. Географічне та сезонне поширення іксодових кліщів відіграють роль у перенесенні збудників Лайм-бореліозу.

КЛЮЧОВІ СЛОВА: іксодові кліщі; хвороба Лайма; німфи; личинки; збудники.

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