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Lyme disease in Humans and Dogs and the Impact of the Pandemic on Its Occurrence Based on the Situation in Poland

Zuzanna Czekaj*

Department of Microbiology, University of Warsaw, Warszawa, Poland

***Corresponding author:** Zuzanna Czekaj, Department of Microbiology, University of Warsaw, Warszawa, Poland, E-mail: zuzanna.czekaj@gmail.com

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Abstract

With the advent of humans and animals on earth, threats to their health appeared. Many diseases have already been eradicated and are not appearing in the population (for example, smallpox, polio, plague, or leprosy). However, newer and newer pathogens appear in their place. Very often, we, as future veterinarians, should educate the public about zoonoses.

For many years, Lyme disease has been an increasing problem in Poland. The area of Poland is considered endemic, which means that there is no safe place where ticks are not infected with Lyme disease, and the lack of this disease in these areas should not be associated with its absence but with the fact that it is not widespread.

Keywords: Lyme disease; Dogs; smallpox; clinical symptoms

Introduction

Picture of Disease in Humans and Dogs

Lyme Disease (LD) is a multisystem inflammatory disease transmitted by Ixodes ricinus ticks infected with Borrelia burgdorferi (B.bg.). Most of the people affected do not even know about its existence, due to the fact that non-specific symptoms appear first in the course of the disease, i.e. those that are also observed in the course of other diseases. The most common symptoms of Lyme disease are muscle and joint pain, fever, general weakness. Of course, in addition to non-specific symptoms, in 50-70% of patients, the characteristic symptom of Lyme disease appears - Erythema Migrans (EM). This erythema appears at the site of a tick bite but it sometimes changes its position on the skin (a kind of metastasis). It has a characteristic pink or purple rim. Afterwards, disturbances in the joint system or the heart may occur within weeks or months. Later in the disease, several months after a tick bite, neurological symptoms may also develop. They are a consequence of inflammation not only of the meninges but also of the brain. They are recorded in 10-20% of people with clinical disease. These disorders may occur individually in each system or coexist.

Lyme disease in animals is slightly different. There haven't been signs of neuroborreliosis in dogs in Poland. However, meningitis, encephalitis, and neuritis occurred in experimentally infected individuals. Surprisingly, no neurological signs were found clinically in these animals. It is similar to the occurrence of migratory erythema. In dogs, reddening of the skin may appear at the site of the bite but this is not typically migratory erythema.

Systemic symptoms may be the only abnormalities seen in Lyme disease. Very commonly, infected dogs show only high fever (> 40 °C), apathy, and enlargement of the lymph nodes. The most common form of Lyme disease in dogs in Poland is the articular form. Bacteria in the joints multiply, leading to increased Il-8 expression and inflammation. The first joint that is most inflamed is the joint closest to the tick bite. Joint symptoms are lameness, joint swelling, and fever. Lameness in Lyme disease is characterized by the possibility of wandering. This means that it initially affects one limb but after a few days, it can affect the others.

Less commonly, dogs suffering from Lyme disease may develop acute glomerulonephritis. The prognosis for this form of the disease is very bad. The very mechanism of the development of glomerulonephritis in the course of Lyme disease is not fully understood. Glomerulonephritis is associated with the loss of protein in urine, leading to edema and fluid accumulation in body cavities.

Methods

Diagnosis

The varied and rich clinical symptomatology of LD makes diagnosis difficult. In humans, the only characteristic symptom is erythema migrans. It is an indication for antibiotic therapy without serological confirmation.

In order to correctly diagnose Lyme disease, it is necessary for the following four elements to coexist:

- Clinical symptoms typical for Lyme disease,

- The presence of antibodies to Borrelia in the serum (however, in the early stage of the disease, antibodies to Borellia burgdorferi are not detected in most patients)
- confirmed contact of the patient with ticks,
- The positive reaction of the patient to the treatment (antibiotic therapy)

A very important element in making a correct diagnosis is an interview with the patient, both human and animal (his owner). Infection occurs at the end of feeding, not earlier than after 24 hours, most often on the third day of feeding. Some sources say that for infection to occur, it is necessary for the tick to stick into the skin for at least 50 hours. Therefore, early removal of arachnids protects against the development of the disease. Thus, it is important to know when the tick was noticed, when it could have stuck into the body, how long the tick stayed in the skin, and how it was removed.

The diagnostic methods for the diagnosis of Lyme disease can be divided into two groups. The first relates to techniques that allow direct detection of bacteria in the tested material (microscopic examination, culture test, PCR), and the second focuses on indirect recognition methods (serological tests).

Borrelia burgdorferi has difficult growing conditions. It requires the use of special substrates (Barbour-Stonner-Kelly - BSK substrate). The breeding takes several weeks and must be kept in anaerobic conditions. The sensitivity of the microbiological test also depends on the diagnostic material. In humans, the most common is a skin biopsy taken from an inflamed area. In this case, the sensitivity of the microbiological test is approximately 70%. This indicator is much lower when we try to isolate the spirochetes, e.g. from the cerebrospinal fluid or synovial fluid.

The most valuable tests (both in human and veterinary medicine) are Enzyme-Linked Immunoabsorbent Tests (ELISA) together with Western-Blotting (WB) tests. The ELISA test has high sensitivity and much lower specificity - therefore, it can give a relatively high percentage of false positives. When whole bacterial cells are used as the antigen in the ELISA test, false-positive results are possible. Especially when an individual has been exposed to antigenically similar spirochetes, such as *Leptospira*. In addition, test in people with autoimmune diseases, rheumatoid arthritis, syphilis, and periodontal disease resulted in reactions. Another factor that hinders the serological diagnosis of Lyme disease is failure to distinguish natural infection from the effects of vaccination when using the ELISA test. Therefore, together with the ELISA test, the Western-blotting test is used. It is highly specific but less sensitive. Hence, the WB test does not so much confirm a positive ELISA result as it eliminates false positives. It should be performed with the same serum sample as the ELISA test.

Treatment of Lyme disease in Animals

Treatment is based on long-term (3-4 weeks) antibiotic therapy. Doxycycline seems to be the antibiotic of choice. Amoxicillin may be administered to animals intolerant to this chemotherapeutic agent or puppies.

A specific reaction noted in dogs with Lyme disease treated with antibiotics is the Jarish- Herxheimer (JHR) reaction. It resembles severe sepsis and is based on an increased release of cytokines (TNF-alpha, IL-6, IL-8). This reaction is accompanied by severe general symptoms such as high fever, increased heart rate, and rapid breathing.

In the case of glomerulonephritis due to Lyme disease, immunosuppressive therapy is used. The most commonly used drugs are methylprednisolone, cyclophosphamide, and azathioprine.

In human medicine, Lyme disease is treated similarly. Selection of an appropriate antibiotic allows for a complete cure. The choice of antibiotic and the route of its administration and the duration of therapy depend on the spread of the disease in the body (involving one or more systems) and the phase of the disease.

Prevention of Borreliosis

In order to prevent the disease, when walking to places especially occupied by ticks (for example a forest or a meadow), it is worth taking precautions, e.g. using insect repellent products, as well as wearing clothing that covers our body as much as possible. After returning home, the entire body should be carefully examined, especially the places on the body that are particularly prone to puncture: bends of the knees, elbows, areas behind the ears, thighs. If a tick is found on the skin, it should be removed as soon as possible. It is important to remove the tick correctly - remember not to squeeze it. By removing the tick within the first 24 hours after injection, the risk of infection is significantly reduced.

In animals, it is recommended to use prophylactic preparations against ectoparasites available in the form of sprays, spot-on preparations, oral tablets and, collars. The most effective prevention of infection requires dogs to be vaccinated against Lyme disease each year before the tick season, at the end of winter.

Borreliosis in Poland before the Pandemic

In recent years, the number of ticks infected with Borrelia has increased exponentially. According to GIS (Polish Main Sanitary Inspectorate), the reasons for the annual increase in the incidence of Lyme disease - from approx. 10/100 thousand in 2005 to approx. 50/100 thousand in 2018 - is greater human susceptibility to infection through contact with ticks. It is estimated that even a quarter of these arachnids pose a threat to humans and animals. The infected ticks are present all

Over Poland and are active from early spring to late autumn. Until 2019, a systematic increase in the incidence of Lyme disease among people could be observed in Poland. From 2016 to 2019, the number of patients every year amounted to over 20,000 people, of which these are only diagnosed cases. We are unable to estimate how many cases were undiagnosed due to the mild course with flu- like symptoms (Figure 1).

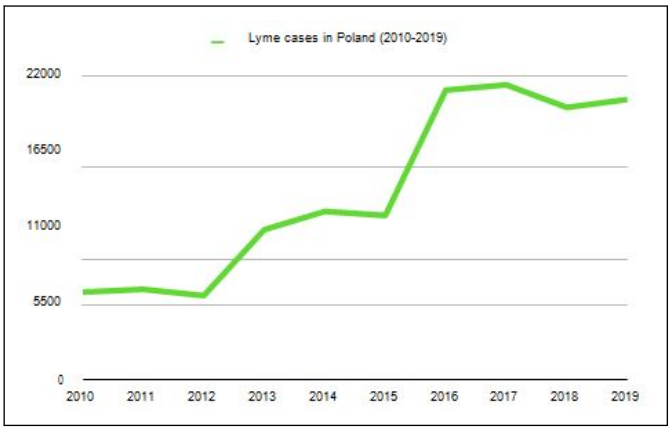

Figure 1: Mild course with flu- like symptoms.

It is difficult to observe trends in the incidence of Lyme disease in dogs in Poland, as it is estimated that the symptoms of the disease occur only in about 5% of infected dogs and appear about 2–5 months after infection. In addition, in Poland it is not one of the diseases that is controlled ex officio, therefore it is not monitored at all. However, using the example of the disease trends in humans, we can assume that over the last few years (until 2019) the number of infected dogs was also increasing. Climate change in Poland particularly speaks to this fact. Increasingly shorter and warmer winters significantly affect the seasonal activity of ticks, extending the period in which they are active. In addition, the area of tick occurrence in Poland has been changed by human activities such as fragmentation of forest ecosystems, the creation of city parks, the development of tourism, and the creation of agrocenoses. It has been proven that in Poland Ixodes ricinus occurs not only in forests but also in city parks, squares, and hiking trails, which also affects the increase in the incidence of Lyme disease in humans and animals.

An additional aspect that may contribute to the increased incidence of Lyme disease in dogs is the anti-vaccination tendency among pet owners. In recent years, movements against vaccination of people (to a much lesser extent, but also of animals) have been expanding in Poland. As a result, the number of children not vaccinated against the most dangerous infectious diseases in our country is growing every year. More and more owners do not want to vaccinate their animals too, including vaccination against Lyme disease. Polish law allows such a situation, as only the rabies vaccine is obligatory for dogs. There is also an increased fear of tick control products in the environment of pet owners. Owners sometimes look for information on the internet instead of seeking advice from a veterinarian. They meet with a certain amount of negative opinions about the side effects of tick collars or spot-on preparations. They forget that when looking for opinions on the internet, there is no doctor next to them who will inform them that each product can cause certain side effects and that if one dog has them, it does not mean that the other will react the same. This information does not always reach the owner when looking for opinions on the Internet.

I believe that all these factors could have contributed to the increase in the incidence of Lyme disease in humans and animals.

The Impact of Pandemic on the Occurrence of Borreliosis in Poland

According to the report of the Department of Epidemiology of Infectious Diseases and Supervision of the National Institute of Public Health, in 2020 the number of Lyme cases among people decreased significantly. The number of cases in 2020 was 12,524, which is almost half as compared to 2019 when 20,630 cases were recorded. There is therefore a sudden downward trend compared to previous years.

The Department of Epidemiology of Infectious Diseases and Supervision of the National Institute of Public Health publishes the number of cases of infectious diseases in Poland every two weeks. Until March 2020, a regular increase in the number of cases of Lyme disease can be observed.

Suddenly, the increase began to decline significantly. Why? (Figure 2).

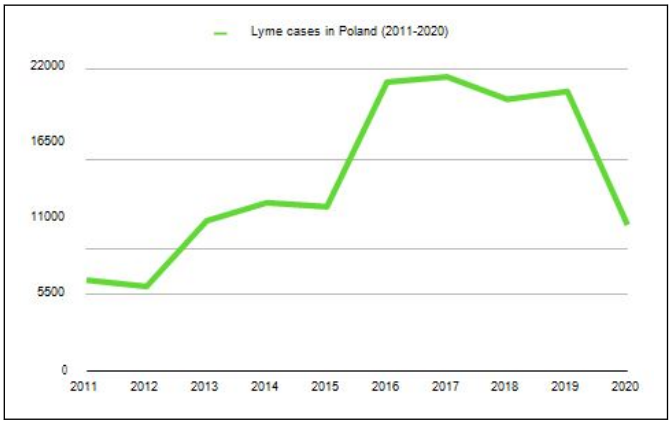

Figure 2: Lyme cases in Poland.

In March 2020, the first case of COVID-19 was diagnosed in Poland, then the national lockdown began and the epidemic state was introduced. Depending on the severity of the occurrence of the coronavirus, the restrictions were increased and decreased but it was recommended to limit leaving the house for a year. Pupils and students learned remotely, cultural institutions and shops in galleries were closed, parties and gatherings were banned, access to parks and beaches was limited, and maximum limits were set for the number of customers in shops. Soon after, hairdressing and beauty salons were closed. At the beginning of April 2020, a temporary ban on access to forests was also introduced. These factors made people less exposed to potentially diseased ticks during this period. Holidays last in Poland from June to August. In 2020, the government loosened the restrictions during this period. The obligation to wear masks outside was lifted, restaurants were reopened, people started going to lakes and forests, which allowed us to observe an increase in both Lyme disease and COVID-19. It resulted to another lockdown and a return to restrictions in October (Figure 3).

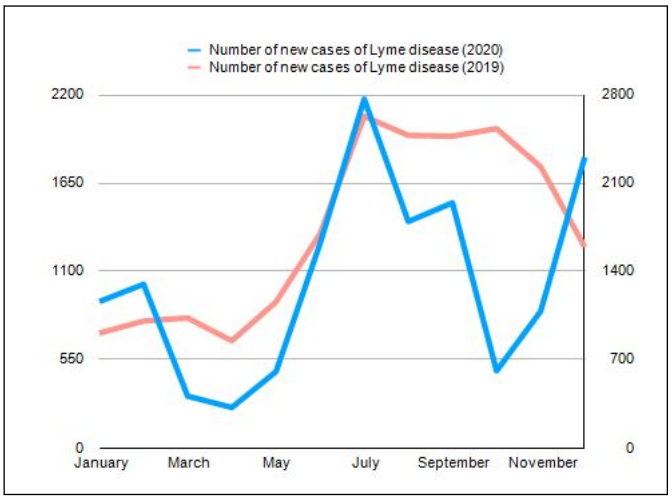

Figure 3: Number of cases of Lyme disease.

Conclusion

Due to the coronavirus, a sanitary regime was in force in Poland from March 2020 to May 2021. People spent most of their time at home. There were fewer walks in parks and forests. It seems that the limitations related to the COVID-19 pandemic are the most important reason for the significantly lower number of cases of Lyme disease in Poland.

Currently, restrictions are being withdrawn in Poland. Anyone can go for a walk, go shopping or go to the forest when they want to. This way, the exposure of humans and animals to ticks increases again. Our role and task as future veterinarians are to educate the public and make them aware of zoonoses and the risks associated with them.

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