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Lyme disease and its zoonotic importance

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Abstract

Lyme disease is a major zoonotic disease which is now spreading to different geographical location beyond its original habitat. The disease affects different animals and ticks act as the transmitting factor. In human the disease is characterized by rash which is accompanied by low-grade fever, headache, fatigue, swollen lymph node and malaise. These early symptoms are then followed by neurologic signs like paralysis of facial muscles, paralysis of facial muscles, large joint pain and swelling, cardiac block, or a chronic skin condition called acroderma chronicum atrophicans. There is very less data about the prevalence of this disease in India but recently few cases have been reported. Proper serological study is much required to study the occurrence of this important zoonotic disease.

Introduction

Lyme borreliosis (LB) is a major zoonotic disease prevalent in Northern hemisphere. The disease has named after Lyme County of Connecticut, where it was first recognized in the year 1975 (Steere *et al*., 1977) following an investigation of a cluster of arthritis cases in children. The disease is mostly prevalent in Europe and North America. In the recent years the disease is reported to be spreading to newer areas, including Asia and Southeast Asia, and has established itself in all the continents of the world. In India the disease was reported to be mostly found in Himalayan region and Northern India but there is very less clinical and epidemiological data of occurrence of this disease. This may be due varied clinical symptoms presented by the disease as well as less awareness among the clinicians as the disease was not prevalent in India in the past.

Etiological agent

Lyme disease is a bacterial, tick-transmitted disease of animals and people. It is caused by the spirochaete *Borrelia burgdorferi* sensu lato and is vectored by the ticks of the *Ixodes* genus which is a hard-shelled tick. Several genospecies of *B. burgdorferi* have subsequently been identified in the USA and Europe (Gilbert, 2021). In the USA, *I. scapularis* (colloquially known as the **deer tick**) act as the vector, on the pacific coast *I. pacificus* is the predominant vector and in Europe and Asia, *I. ricinus and I. persulcatus* are the primary vectors.

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Epidemiology

Previously this disease was found in temperate areas in the northern hemisphere and sporadic occurrence was observed in Europe and Asia but due to globalization the incidence of Lyme borreliosis is increasing due to the expanding geographic range of tick vectors. The spirochete is transmitted by ticks that have a blood meal during each of their three life stages: larval, nymphal and adult. The risk of infection depends mostly on the population of these ticks in a specific locality as well as their feeding habits and animal hosts, which have evolved differently in different locations. There is no any evidence of natural transmission from person to person.

Transmission of the disease

Transmission occurs mainly through the bite of the infected tick. For transmission of the bacteria the tick needs to attached to the skin for about 36-48 hours. Person to person transmission is not present in this disease. Predisposing factors for lyme disease include the work environment, participation in outdoor activities, geographical area and season.

Borreliosis in animals

Lyme disease can be observed in many species of animals like dog, cat and horses. In animals most infections are subclinical in nature and clinical manifestation of the disease mainly relate to the site of localization of the organism. In dogs clinical disease is reported frequently and it is characterised by fever, lethargy, arthritis and sometimes involvement of cardiac, renal and nervous system (Elhelw *et al*., 2021). In case of horses there is involvement of nervous systems and it is known as neuroborreliosis. Horses with neuroborreliosis will exhibit clinical signs like atrophy of spinal muscles, dysphagia, laryngeal dysfunction, facial paresis, spinal cord ataxia and paresis, behavioral changes, and hyperesthesia.

Horses with neuroborreliosis may also other neurologic disorders like meningitis, cranial nerve dysfunction. Other clinical signs in horses, such as intermittent, shifting lameness, have not been conclusively linked to Lyme borreliosis. Lameness in cattle and sheep associated with *B. burgdorferi sensu lato* infection has also been reported. Most seropositive dogs and horses are asymptomatic.

DIAGNOSIS

- Diagnosis can be done on the basis of a combination of history, clinical signs, laboratory data, response to therapy, and exclusion of other diseases
- Serological testing can be done
- Culture and PCR can be conducted to detect spirochetes

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- Differential diagnosis of the disease should be done along with a history of exposure to ticks recently, clinical signs, supporting laboratory data, and response to therapy.

Treatment

- In clinically infected animals a long course of antibiotics (4 weeks) is indicated to treat infection
- Symptomatic therapy should be provided
- In the case of infection-related autoimmune reactions Immunosuppressive therapy is provided
- Some animals may remain seropositive after successful treatment
- In case of dogs, **doxycycline** (10 mg/kg, PO, every 12 hours) and amoxicillin (20 mg/kg, PO, every 8 hours) are very effective.
- Four-week courses of **doxycycline** (10 mg/kg, PO, twice a day) or **minocycline** (4 mg/kg, PO, twice a day) have reportedly been successful in treating Lyme borreliosis in horses

Zoonotic potential in humans

Lyme disease is a zoonotic infection and humans are an accidental host; dogs, horses, and other domestic animals also exhibit symptomatic infection. In humans there is clinical manisfestations within days within days to weeks after the bite from an infected tick. Clinical manifestations are not always an inevitable outcome of lyme disease. Seroepidemiological studies in Lyme disease endemic areas have shown that large proportions of persons with antibodies to *B. burgdorferi* are asymptomatic (Carlsson *et al*., 2018). According to Centers for Disease Control And Prevention, about 300000 cases of Lyme disease occurs yearly in the U.S alone. Early Lyme disease is characterized by an expanding skin rash called erythema migrans at the site of the tick bite, accompanied by low-grade fever, headache, fatigue, swollen lymph node and malaise. The rash appears similar to a single circle that slowly spreads from the site of the tick bite. The rash becomes clear in the center and resembles a target or bull's-eye. The rash often feels warm to the touch, but it's usually not painful or itchy. These early symptoms is then followed by neurologic signs like paralysis of facial muscles, paralysis of facial muscles, large joint pain and swelling, cardiac block, or a chronic skin condition called acroderma chronicum atrophicans. Lyme carditis is severe complication of the disease where the patient will suffer from heart palpitations, chest pain, shortness of breath or fainting.

Diagnosis and Tests

- A history of exposure to tick infestation in an endemic area in association with characteristic clinical signs may suggest Lyme disease.
- Rising antibody titres to *B. burgdorferi* sensu lato along with typical clinical signs are indicative of disease.
- Other blood work may reveal elevated ESR, leukopenia, and thrombocytopenia. Joint aspiration is only recommended if one suspects septic arthritis.

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- Immunofluorescence assays may also be used but the results of these methods may be difficult to interpret.
- Culture of borreliae from clinically affected animals is confirmatory. Cultures in Barbour-Stoenner-Kelly medium should be incubated for 6 weeks under microaerophilic conditions and should be carried out in specialized laboratories.
- Low numbers of borreliae can be detected in samples by PCR techniques.

Treatment / Management

- Treatment is provided on the basis of age and severity of the disease
- For patients older than 8 years of age with early, localized disease, doxycycline is recommended for 10 days.
- For young patients under the age of 8 amoxicillin or cefuroxime can be administered for 14 days to avoid the potential for tooth staining caused by tetracycline use in young children.
- Longer courses and parenteral antibiotics may be required for more severe manifestations such as arthritis, atrioventricular heart block, carditis, meningitis, or encephalitis is present

Conclusion

Lyme disease is one of the most common vectors borne disease in the temperate regions. In India the occurance is less, maybe due to the geographic condition or proper sero surveilence is not conducted in large area.). The first case in India was reported from Shimla in 1990 (Patial *et al*., 1990). Another study reported the presence of high *B. burgdorferi* IgG seroprevalence among military personnel in the North-Eastern states of India (Praharaj *et al*.2008). Reports of 18 number of sero-positive cases were documented from northern India in the year 2021(Vinayaraj *et al*., 2021). With the increase in connectivity between various geographical regions the ticks are now found in nonnative areas. There is an immediate need for making physicians, medicine practitioners as well as Veterinarians aware about the possibility of these diseases. Effort should be made to isolate the organism from the clinical specimens and vectors to understand the antigenic differences in detail. A proper sero-surveillance should be conducted to study the distribution and occurances of the disease in Indian population.

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