

# Introduction, Sign, Symptoms, Prevention and Management of Lyme Disease Caused by *Borrelia burgdorferi* Channeled through *Ixodes* Ticks as Vector. A Review

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## Abstract

God has created many miraculous creature; ticks are one of them. *Borrelia burgdorferi* is a bacterium that lives into the gut of ticks. When such ticks feed upon the blood of Ticks and other livestock, bacteria are transferred into their blood stream of these hosts. A disease is caused into human beings if such infected tick bites humans that are called as Lyme disease. This review will help to have a keen study on the cause, sign, symptoms, prevention and management of this disease.

## Keywords

*Borrelia burgdorferi*, Livestocks

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## 1. Introduction

Lyme disease is caused by ticks. There are about 800 different species of ticks. They have two families family Argasidae that have about 160 species. Second family is of hard ticks that has 650 species. Ticks and ticks are considered as close relatives of mites regarding their parasitic life style. Ticks have complex life style. They need more than one type of hosts to spend their life; for example American Dog ticks is a three host ticks. Ticks can live alive for years in the absence of their host so it is a facultative host [1].

Ticks are very small in size; victim cannot identify easily where ticks have bitten. Typically when ticks bite redness of the skin is first symptom. This redness expands to form an annular lesion having red borders. About 35 percent of patients in USA have

lesions with clear central part that maybe necrotic or vesicular [2] [3].

The life circle of *Borrelia burgdorferi* is transferred via Ticks. Four developmental stages are occurred under the life of Ticks. Larvae are infected with bacteria when a larva feeds upon mice. After molting larvae transferred into nymphs. Ticks spread infection to humans via some small animals like white tailed mouse, deer, some birds all act as reservoirs for *B. burgdorferi*.

Most infection of LD is because of the biting of Nymph because Nymph has poppy seed size and it is not visible by the victim. The whole life circle of *B. burgdorferi* needed 36 to 48 hours for attachment. Circle in this way the life circle is completed [4] [5].

Development of ticks started when the eggs are hatched into six legged Larvae. Nymphs and adults are also eight legged. There are two groups of ticks *i.e.* soft and hard ticks. Soft ticks have seven nymph instars while hard ticks have one nymph instars [6].

Ticks have two chance to get infect with *Borrelia burgdorferi i.e.* during larval and nymph stages. So humans are at the peak of risk during spring and summer season, because ticks are active at that season [7]-[9].

The alternative name of Lyme disease is as *Lyme borreliosis*. At least three stages are present in the course of Lyme disease (1) acute (2) early disseminated (3) chronic [10].

*Lyme* disease was first time observed in Europe; it gradually prevails into American countries rapidly. It is a disease that is spread through Bacteria with the help of a vector *i.e.* Tick.

Humans are affected badly because it adversely affects the central nervous system, skin, joints of legs and allergy on whole body is mostly observed. If cutaneous infection is encountered it is referred to as erythema migrans [11].

If cutaneous infection resulted, it is referred to as erythema migrans. Lyme disease is caused by a bacteria *Borrelia burgdorferi*. It has corkscrew shape and is a member of spirochetes [12].

After the study at laboratory level it is predicted that about forty to forty eight hours are required for the infection [13].

## 2. Disease Sign and Symptoms

Lyme disease is considered as asymptomatic disease. The culturing of *B. burgdorferi* is a tool in expanding the knowledge and understanding about the sub species [14]-[16]. Symptoms appeared within one month after the insect bite. Tick feed for 24 to 36 hours on the blood of victim to transfer the bacterial agent. During this period bacteria transfer from the gut of tick into the saliva of tick and finally it reaches into the body of host. So bacteria use Tick as vector. If ticks bite for short time it does not causes infection [17].

The first symptom of disease is the appearance of redness on skin that may call bull's eye rash or erythematic migrans present on infected individuals. About seventy to eighty percent of infected individuals developed erythema migrans only a slight differ-

ence in the size and shape [18].

The most common sign and symptoms includes skin-rash at which ticks are attached. Infection spread from centre to outward converting the skin into dark red [19].

The most observable symptoms include fever, hardness of neck, flu, headache, and headache, inflammation of muscles and joints and fatigue. To nip the evil in bud is the solution of early stage symptoms [20].

Later stage symptoms of LD may take weeks to years to become prominent. If untreated, late stage symptoms are encountered that affect heart, joints, and CNS also [21].

About sixty percent of patients are affected with arthritis; if treatment is not started on early basis. This may lead to chronic infection. Nervous system is also adversely affected. Lyme disease affects the nervous system in second stage. The most probable symptoms includes hardness and stiffness of the neck region, waves of pain in head, meningitis, peripheral rediculopathy at peripheral region, fear from light and long term vomiting shows meningeal involvement [21]-[23]. Heart beat slows down because of this disorder that leads to senselessness of the patient [22].

The disease is spread through the biting of an infected black legged tick (*Ixodes scapularis*) and it can bite to an individual of any age. Tick itself is infected with bacteria when it bites a man it sucks blood and ultimately transfers bacteria into the body of human. Within three to 33 days symptoms may appear that includes allergy and neural disorder and joints problem. However it is not transmitted under touching, kissing and intercourse [23].

Halprein *et al.* (2011) described the symptoms of LD in case of brain. He called the brain symptoms as Brain Frog. Because of this, patients feel fatigue tiredness and mentally absence for most of their time. The infection of Brain because of *Borrelia burgdorferi* is referred as meningitis [24] [25].

In meningitis there is risk of getting benign tumor. LD also affects CSF, spinal cord and often leads to encephalomyelitis. Fortunately this disorder can be cured by taking antibiotics regularly [26].

The other constitutional sign and symptoms includes arthralgias, myalgias, lymphadenopathy and hectic fatigue are more noticeable symptoms. About ten percent of victims do not show the redness of skin [27].

Patients may also show the symptoms of high temperature, headache, leucopenia, lymphopenia, myalgias, increased liver enzyme content and thrombocytopenia [28].

Variable symptoms that may appear in patients include loss of memory, muscles fatigue, depression, headache, irritability and problem in sleeping [29]. Most of the symptoms are the chronic Lyme disease [30].

Depression, anxiety, loss of temperament and rage are the symptoms of acute and chronic Lyme disease [31].

Initial symptoms include bulls eye *i.e.* erythema migrans, but about fifty one percent of patients do not show rashes [32]. Rashes may be flat in shape [33]. Rashes are just as are formed by the biting of spider and ringworm [34].

### 3. Medication and Prevention of Disease

Diagnosis is important before medication. Different tests are used under different circumstances. ELISA test is used to identify the increased *Borrelia* antibodies [35].

Diagnosis and treatment is different in both International Lyme and Associated Disease Society (ILDS) and IDSA [36] [37].

These fluctuations predict that doctors do not use constant method for diagnosis and cure. About more than four weeks are required to treat LD [38]-[47].

Protein Immunoblots test, western Blot tests, Melisa test, LTT, Elispot, test of CSF, PCR method, Dark field microscopy, FFM are the most probable test used for diagnosis [48].

For patients suffering with Erythema migrans are suggested to take Doxycycline (100 mg/per 2 day) [49].

Serology testing is often used for the diagnosis of LD, but it shows some drawback because it does not help to distinguish between active and inactive infection and patient shows sero-positive for many years even antibiotics are administered regularly [50] [51].

Gary *et al.* gave guidelines for the management of Lyme disease. Prevention is better than cure, by focusing this formula he concluded that special care must be given to diseased person or those are at risk of getting disease [52]-[55].

The most effective tools that are used for the prevention of disease includes 1) prevent our selves from the exposure of ticks as much as possible; 2) avoid to travel in a brushy areas; 3) use of light coloured dresses that help to detect the sitting of Ticks immediately; 4) use of full sleeved shirt; 5) for the sake of foot use top socks; 6) use of insect repellents regularly; 7) monitoring the ticks visit on daily basis; 8) if ticks is attached on one's body remove it abruptly. We should aware of the fact that Lyme disease is vector pinched disease. We can prevent us from the exposure of ticks but unfortunately, if one gets ticks bite, one should have clinical checkup and if test is positive he/she should have its complete treatment until the end of disease [56].

Gary *et al.* recommended Amoxicillin, Doxycycline, *Cefuroxime axetil*, ceftriaxone, cefotaxime and penicillin G. the concentration of all these medicines is different for both adults and children [57].

According to a survey, if one gets the symptoms of LD one should experience through the whole course of antibiotics tablets, liquids and capsules. Duration of intake varied from person to person. If health-condition is better than before; it shows that all bacteria have been killed. If health is not getting normalize one should refer to some specialist [58].

Biological control can be used for the prevention of LD for example entomopathogenic fungi is use that causes the destruction of Ticks [59].

We should reduce the number of deer in an area because deer are the blood meal of Ticks. Antimicrobial Prophylaxis is used in Europe but prophylactic is under controversial issue [60].

According to the survey by the centers for disease control and prevention about 3 lac people are suffering with LD in which 25 percent are children. Such a high rate of pa-

tients is because of carelessness, late diagnosis, wrong testing, wrong medication etc. [61].

One of the most accurate tests for the diagnosis of LD is Human Tissue Biopsies test. It is helpful in determining the persistence of Lyme bacteria [62].

#### 4. Treatment of LD

Antimicrobial therapy is used for the treatment of LD. If redness on skin, isolated facial nerve palsy and mild cardiac disease occur, antibiotics are taken orally for 14 - 21 days. If the symptoms of meningitis and radiculoneuritis are noticed, antibiotics are administered intravenously for 10 - 28 days. If patients are facing with first stage block with PR interval of  $\geq 0.3$ , second or third stage atrioventricular block such patients must be referred to hospital for complete monitoring of heart. The therapy used for neuroborreliosis is the uptake of antibiotics intravenously for 14 - 28 days. For Arthritis, oral regimen is used if results are not satisfactory they should take regimen intravenously for 14 - 28 days. If patients do not show improvement he may have Antibiotic-refractory Lyme arthritis [11] [18].

An OspA-based vaccine was used to prevent LD, but it was banned because of poor sales and theoretic concerns about triggering autoimmune arthritis [63] [64].

About 65% - 80% of the disorder can be eradicated by using intravenous ceftriaxone for two to four weeks [65].

For the treatment of LD steroid therapy was used but it is not recommended now because of bad outcomes and immune suppression [66].

If antibiotics treatment does not give satisfactory results for the joints of knee surgical synovectomy is recommended [66].

Other therapies that are used against LD are symptomatic therapy. It is an anti-inflammatory treatment that is often used when victim is failed to response to antibiotics [67].

Other therapy is the hyperbaric oxygen therapy is under studies but it's not used for regular concerns [68].

Chronic Lyme disease is an intermingled term that can be described for different populations of patients included early, late Lyme disease and no evidence of Lyme disease [69]-[71].

*Ixodes* ticks also causes co-infection for humans causing HGA (human granulocytic anaplasmosis). Concluding, laboratories at commercial level offers non-validated Lyme diagnostic test is not appreciated now a day's [72].

Recently it has been observed that when the ticks bite humans the Auto-reactive T cells are activated because of tremendous inflammation. It is the first response of immune system locating in our body for defense that triggers to inhibit the infection [73]-[75].

#### 5. Conclusion

It is a highly infectious disease. Advancement in research leads to the better diagnosis

and describes the main feature of disease, isolation and culturing of germ. In upcoming era it is expected that the interaction between bacteria, vector and Host will be understood. This collection of words should develop new insights that will help in the better diagnosis, treatment and management of disease.

## 6. Recommendation

Prevention from the exposure of Ticks must be first priority. Nip the disease in the bud if infection occurs.

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## List of Abbreviations

LD: Lyme Disease

*B. burgdorferi*: *Borrelia burgdorferi*

CSF: Cerebral spinal Fluid

CNS: Central Nervous System

HGA: Human granulocytic Anaplasmosis

ILADS: International Lyme Associated Disease Society



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