Lyme Disease Protocol:

Each person heals at a different rate. Depending upon their constitution, body imbalances, present and past stress, genetic predispositions, dietary habits and neurological health. Dosages, treatment and lab testing should be monitored by a practitioner. The remedies used are of the highest quality available. Select wildcrafted herbs and special manufacturing methods are used in the remedies to extract the vital healing and energetic characteristics of each herb. The Integrative Wellness & Research Center only treats from a drugless view due to the destructive aspects of synthetic drugs.

The products listed below are a sampling of the ones used at the Wellness Center.

Dr John's Best Shot: Anti-lyme, anti-parasitic, antimicrobial formula to give your body the best shot in overcoming this terrible complex disease.

Dr. John's Master: Herbal properties are antimutagenic, immunomodulator, anti-inflammatory, anti-viral, antitumorus, cytostatic, anti-fungal, antimicrobial and vermifuge. This product is a must for overcoming lyme due to its pleomorphic nature..

Dr. John's Lymph: Anti-viral in nature, breaks up congestive lymphs nodes, supports in fighting infections in the lymph glands and ads in detoxification.

SyInfect/Syntrion: Modulates immunity and supports your bodies ability to fight infections.

SyCircue/Syntrion: Helps to breaks up fibrinogen and congestive tissue. Down-regulates the hyper immune response from infectious disease.

Boluoke: Anti-Inflammatory and Antiplatelet effects.

Biozyme: Pancreatic enzymes full strength, undiluted 10x to help break down fats, carbohydrates and proteins.

Transfer Factor LymPlus: Immune function targeted support for Borrelia burgdorferi, Babesia, Erlichia and others.

Transfer Factor Multi-Immune: (1)Clinicals demostrated a 235% increase in NK cell function of immune compromised patients: doubling the dose to 2 caps bid increased NK cell function by over 600%. Some healthcare professionals increase to 3 caps TID during acute periods.

NT Factor Energy: (1)Clinicals showing 40% reduction in fatigue in eight weeks. For several fatigue, increase to nine tablets per day during the first two months.

* These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure or prevent disease.

(1) Research studies are available on Researched Nutritionals.com website.

Lab Testing:

Effective testing methods to access lyme disease and immune response. Lyme disease is caused by Borrelia burgdorferi, a tick-transmitted spirochetal bacterium. If left untreated, later symptoms may involve the joints, heart, and nervous system.

Lyme Immune ID: an effective test method that provides assessment of memory T cell response and detects Borrelia burgdorferi infection even at low levels. In addition, the test also includes cytokine analysis that offers the ability to evaluate the inflammatory immune response of Borrelia burgdorferi antigens.
Western Blot
NeuroAdrenal
GI Effects Stool Test
Organic Acid Profile with oxidative stress
Hormones
CBC 24
Complete Thyroid
Complete Cholesterol
CRP-inflammatory marker
other blood test available as needed.

Chronic Lyme disease is can be difficult to diagnose without proper testing. It is capable of mimicking many different disease processes, including multiple sclerosis, rheumatoid arthritis, fibromyalgia, Tourette's syndrome, stroke, meningitis, ADHD, cancer, celiac disease, IBS, depression and autoimmune and neurological disorders just to name a few.

Once it is determined that Lyme disease is indeed responsible for a patient's illness the true challenge begins. *Borellia burgdorferi* has proven to be an extremely difficult organism to eradicate. There are several reasons for this.

Borellia burgdorferi is capable of accessing areas of the body that are inaccessible to both the immune system and antibiotics. One example of this is the ability of the organism to penetrate the blood-brain barrier, a feat difficult at best for synthetic antibiotics.

Although primarily an extra-cellular organism, Bb is often found inside many different types of host cells including blood macrophages, endothelium and fibroblasts.

Even if caught outside the cells by the host immune system, Bb have the ability to change their surface proteins to disguise themselves. They also have other mutagenic properties that allow them to change their form completely into spheroplasts which lack a cell wall. Spheroplasts have a much easier time staying under the radar of the immune system and are very resistant to synthetic antibiotics. Once the danger has passed the spheroplasts convert back into the spirochete form of Bb.

Bb is also capable of suppressing the host immune system through various means, including the immune complex.

Treatments for acute infections consist of 6 months of treatments and then follow-up lab test. In chronic infections treatments are much longer in duration. If Bb is allowed to disseminate throughout the body, as occurs in chronic conditions, it becomes more difficult to treat, but not impossible.

American Lyme Disease Foundation.

Tick species that transmit Lyme Disease: Black-legged tick (Deer tick), western black-legged tick

What is Lyme Disease?

Click here for pictures of deer ticks

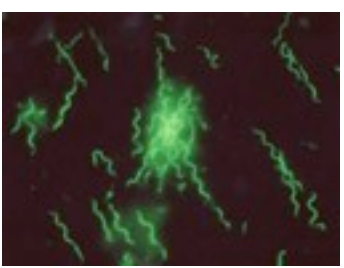
Lyme disease (LD) is an infection caused by *Borrelia burgdorferi*, a type of bacterium called a spirochete (pronounced spy-ro-keet) that is carried by deer ticks. An infected tick can transmit the spirochete to the humans and animals it bites. Untreated, the bacterium travels through the bloodstream, establishes itself in various body tissues, and can cause a number of symptoms, some of which are severe.

LD manifests itself as a multi-system inflammatory disease that affects the skin in its early, localized stage, and spreads to the joints, nervous system and, to a lesser extent, other organ systems in its later, disseminated stages. If diagnosed and treated early with antibiotics, LD is

almost always readily cured. Generally, LD in its later stages can also be treated effectively, but because the rate of disease progression and individual response to treatment varies from one patient to the next, some patients may have symptoms that linger for months or even years following treatment. In rare instances, LD causes permanent damage.

Although LD is now the most common arthropod-borne illness in the U.S. (more than 150,000 cases have been reported to the Centers for Disease Control and Prevention [CDC] since 1982), its diagnosis and treatment can be challenging for clinicians due to its diverse manifestations and the limitations of currently available serological (blood) tests.

The prevalence of LD in the northeast and upper mid-west is due to the presence of large numbers of the deer tick's preferred hosts - white-footed mice and deer - and their proximity to humans. White-footed mice serve as the principal "reservoirs of infection" on which many larval and nymphal (juvenile) ticks feed and become infected with the LD spirochete. An infected tick can then transmit infection the next time it feeds on another host (e.g., an unsuspecting human).



Borrelia burgdorferi

The LD spirochete, *Borrelia burgdorferi*, infects other species of ticks but is known to be transmitted to humans and other animals only by the deer tick (also known as the black-legged tick) and the related Western black-legged tick. Studies have shown that an infected tick normally cannot begin

transmitting the spirochete until it has been attached to its host about 36-48 hours; the best line of defense against LD, therefore, is to examine yourself at least once daily and remove any ticks before they become engorged (swollen) with blood.

Generally, if you discover a deer tick attached to your skin that has not yet become engorged, it has not been there long enough to transmit the LD spirochete. Nevertheless, it is advisable to be alert in case any symptoms do appear; a red rash (especially surrounding the tick bite), flu-like symptoms, or joint pains in the first month following any deer tick bite could signal the onset of LD.

Manifestations of what we now call Lyme disease were first reported in medical literature in Europe in 1883. Over the years, various clinical signs of this illness have been noted as separate medical conditions: acrodermatitis, chronica atrophicans (ACA), lymphadenosis benigna cutis (LABC), erythema migrans (EM), and lymphocytic meningradiculitis (Bannwarth's syndrome). However, these diverse manifestations were not recognized as indicators of a single infectious illness until 1975, when LD was described following an outbreak of apparent juvenile arthritis, preceded by a rash, among residents of Lyme, Connecticut.

Where is Lyme Disease Prevalent?

LD is spreading slowly along and inland from the upper east coast, as well as in the upper midwest. The mode of spread is not entirely clear and is probably due to a number of factors such as bird migration, mobility of deer and other large mammals, and infected ticks dropping off of pets as people travel around the country. It is also prevalent in northern California and Oregon coast, but there is little evidence of spread.

In order to assess LD risk you should know whether infected deer ticks are active in your area or in places you may visit. The population density and percentage of infected ticks that may transmit LD vary markedly from one region of the country to another. There is even great variation from county to county within a state and from area to area within a county. For example,

less than 5% of adult ticks south of Maryland are infected with *B. burgdorferi*, while up to 50% are infected in hyper-endemic areas (areas with a high tick infection rate) of the northeast. The tick infection rate in Pacific coastal states is between 2% and 4%.

U.S. Range Maps and Statistics

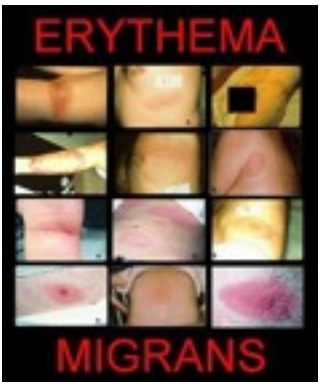
To view U.S. Range Maps and Statistics for Lyme disease, click here.

Symptoms

The spirochetal agent of Lyme disease, *Borrelia burgdoferi*, is transmitted to humans through a bite of a nymphal stage deer tick *Ixodes scapularis* (or *Ixodes pacificus* on the West Coast). The duration of tick attachment and feeding is a key factor in transmission. Proper identification of tick species and feeding duration aids in determining the probability of infection and the risk of developing Lyme disease.

Spirochete transmission poster: how long has that tick been feeding on you?

The early symptoms of LD can be mild and easily overlooked. People who are aware of the risk of LD in their communities and who do not ignore the sometimes subtle early symptoms are most likely to seek medical attention and treatment early enough to be assured of a full recovery.



Click here for pictures of EM's

The first symptom is usually **an expanding rash** (called erythema migrans, or EM, in medical terms) which is thought to occur in 80% to 90% of all LD cases. An EM rash generally has the following characteristics:

- Usually (but not always) radiates from the site of the tick bite
- Appears either as a solid red expanding rash or blotch, OR a central spot surrounded by clear skin that is in turn ringed by an expanding red rash (looks like a bull's-eye)
- Appears an average of 1 to 2 weeks (range = 3 to 30 days) after disease transmission
- Has an average diameter of 5 to 6 inches (range = 2 inches to 2 feet)
- Persists for about 3 to 5 weeks
- May or may not be warm to the touch
- Is usually not painful or itchy

EM rashes appearing on brown-skinned or sun-tanned patients may be more difficult to identify because of decreased contrast between light-skinned tones and the red rash. A dark, bruise-like appearance is more common on

dark-skinned patients.

Ticks will attach anywhere on the body, but prefer body creases such as the armpit, groin, back of the knee, and nape of the neck; rashes will therefore often appear in (but are not restricted to) these areas. Please note that multiple rashes may, in some cases, appear elsewhere on the body some time after the initial rash, or, in a few cases, in the absence of an initial rash.

Around the time the rash appears, other symptoms such as **joint pains, chills, fever, and fatigue** are common, but they may not seem serious enough to require medical attention. These symptoms may be brief, only to recur as a broader spectrum of symptoms as the disease progresses.

As the LD spirochete continues spreading through the body, a number of other symptoms including **severe fatigue, a stiff, aching neck**, and peripheral nervous system (PNS) involvement such as **tingling or numbness in the extremities or facial palsy (paralysis)** can occur.

The more severe, potentially debilitating symptoms of later-stage LD may occur weeks, months, or, in a few cases, years after a tick bite. These can include **severe headaches, painful arthritis and swelling of joints, cardiac abnormalities**, and central nervous system (CNS) involvement leading to **cognitive (mental) disorders**.

The following is a checklist of common symptoms seen in various stages of LD:

Localized Early (Acute) Stage:

- Solid red or bull's-eye rash, usually at site of bite
- Swelling of lymph glands near tick bite
- Generalized achiness
- Headache

Early Disseminated Stage:

- Two or more rashes not at site of bite
- Migrating pains in joints/tendons
- Headache
- Stiff, aching neck
- Facial palsy (facial paralysis similar to Bell's palsy)
- Tingling or numbness in extremities
- Multiple enlarged lymph glands
- Abnormal pulse
- Sore throat
- Changes in vision
- Fever of 100 to 102 F
- Severe fatigue

Late Stage:

- Arthritis (pain/swelling) of one or two large joints
- Disabling neurological disorders (disorientation; confusion; dizziness; short-term memory loss; inability to concentrate, finish sentences or follow conversations; mental "fog")
- Numbness in arms/hands or legs/feet

Diagnosis

If you think you have LD symptoms you should see your physician immediately. The EM rash, which may occur in up to 90% of the reported cases, is a specific feature of LD, and treatment should begin immediately.

Even in the absence of an EM rash, diagnosis of **early** LD should be made on the basis of symptoms and evidence of a tick bite, not blood tests, which can often give false results if performed in the **first month after initial infection** (later on, the tests are more reliable). If you live in an endemic area, have symptoms consistent with early LD and suspect recent exposure to a tick, present your suspicion to your doctor so that he or she may make a more informed diagnosis.

If early symptoms are undetected or ignored, you may develop more severe symptoms weeks, months or perhaps years after you were infected. In this case, the CDC recommends using the ELISA and Western-blot blood tests to

determine whether you are infected. These tests, as noted above, are considered more reliable and accurate when performed at least a month after initial infection, although no test is 100% accurate.

If you have neurological symptoms or swollen joints your doctor may, in addition, recommend a PCR (Polymerase Chain Reaction) test via a spinal tap or withdrawal of synovial fluid from an affected joint. This test amplifies the DNA of the spirochete and will usually indicate its presence.

Treatment

Recommended courses and duration of treatment for both early and late Lyme symptoms are shown in our Table of Recommended Antibiotics and Dosages (see also table footnotes).

Early treatment of LD (within the first few weeks after initial infection) is straightforward and almost always results in a full cure. Treatment begun after the first three weeks will also likely provide a cure, but the cure rate decreases the longer treatment is delayed.

Doxycycline, amoxicillin and ceftin are the three oral antibiotics most highly recommended for treatment of all but a few symptoms of LD. A recent study of Lyme arthritis in the New England Journal of Medicine indicates that a four-week course of oral doxycycline is just as effective in treating late LD, and much less expensive, than a similar course of intravenous Ceftriaxone (Rocephin) unless neurological or severe cardiac abnormalities are present. **If these symptoms are present**, the study recommends immediate intravenous (IV) treatment.

Treatment of late-Lyme patients can be more complicated. Usually LD in its later stages can be treated effectively, but individual variation in the rate of disease progression and response to treatment may, in some cases, render standard antibiotic treatment regimens ineffective. In a small percentage of late-Lyme patients, the disease may persist for many months or even years. These patients will experience slow improvement and resolution of their

persisting symptoms following oral or IV treatment that eliminated the infection.

Although treatment approaches for patients with late-stage LD have become a matter of considerable debate, many physicians and the Infectious Disease Society of America recognize that, in some cases, several courses of either oral or IV (depending on the symptoms presented) antibiotic treatment may be indicated. However, long-term IV treatment courses (longer than the recommended 4-6 weeks) are not usually advised due to adverse side effects. While there is some speculation that long-term courses may be more effective than the recommended 4-6 weeks, there is currently no scientific evidence to support this assertion. Click here for an article from the New England Journal of Medicine which presents clinical recommendations in the treatment and prevention of early Lyme disease.

Prevention & Control

Larval and nymphal deer ticks often hide in shady, moist ground litter, but adults can often be found above the ground clinging to tall grass, brush, and shrubs. They also inhabit lawns and gardens, especially at the edges of woodlands and around old stone walls where deer and white-footed mice, the ticks' preferred hosts, thrive. Within the endemic range of *B. burgdorferi* (the spirochete that infects the deer tick and causes LD), no natural, vegetated area can be considered completely free of infected ticks.

Deer ticks cannot jump or fly, and do not drop from above onto a passing animal. Potential hosts (which include all wild birds and mammals, domestic animals, and humans) acquire ticks only by direct contact with them. Once a tick latches onto human skin it generally climbs upward until it reaches a protected or creased area, often the back of the knee, groin, navel, armpit, ears, or nape of the neck. It then begins the process of inserting its mouthparts into the skin until it reaches the blood supply.

In tick-infested areas, the best precaution against LD is to avoid contact with soil, leaf litter and vegetation as much as possible. However, if you garden, hike, camp, hunt, work outdoors or otherwise spend time in woods, brush or

overgrown fields, you should use a **combination of precautions** to dramatically reduce your chances of getting Lyme disease:

First, using color and size as indicators, learn how to distinguish between:

Deer tick larva (top), nymph (right) and adult (left).

- deer tick* nymphs and adults
- deer ticks and two other common tick species - dog ticks and Lone Star ticks (neither of which is known to transmit Lyme disease)

*Deer ticks are found east of the Rockies; their look-alike close relatives, the western black-legged ticks, are found and can transmit Lyme disease west of the Rockies.

Dog tick.

Lone star tick.

Then, when spending time outdoors, make these easy precautions part of your routine:

- **Wear enclosed shoes and light-colored clothing** with a tight weave to spot ticks easily
- **Scan clothes and any exposed skin frequently** for ticks while outdoors
- **Stay on cleared, well-traveled trails**
- **Use insect repellant containing DEET (Diethyl-meta-toluamide)** on skin or clothes if you intend to go off-trail or into overgrown areas
- **Avoid sitting directly on the ground or on stone walls** (havens for ticks and their hosts)

- **Keep long hair tied back**, especially when gardening
- **Do a final, full-body tick-check at the end of the day** (also check children and pets)

When taking the above precautions, consider these important facts:

- If you tuck long pants into socks and shirts into pants, be aware that ticks that contact your clothes will climb upward in search of exposed skin. This means they may climb to hidden areas of the head and neck if not intercepted first; spot-check clothes frequently.
- Clothes can be sprayed with either DEET or Permethrin. Only DEET can be used on exposed skin, but never in high concentrations; follow the manufacturer's directions.
- Upon returning home, clothes can be spun in the dryer for 20 minutes to kill any unseen ticks
- A shower and shampoo may help to remove crawling ticks, but will not remove attached ticks. Inspect yourself and your children carefully after a shower. Keep in mind that nymphal deer ticks are the size of poppy seeds; adult deer ticks are the size of apple seeds.

Any contact with vegetation, even playing in the yard, can result in exposure to ticks, so careful daily self-inspection is necessary whenever you engage in outdoor activities and the temperature exceeds 45° F (the temperature above which deer ticks are active). Frequent tick checks should be followed by a systematic, whole-body examination each night before going to bed. Performed consistently, this ritual is perhaps the single most effective current method for prevention of Lyme disease.

Video of Proper Tick Removal

If you DO find a tick attached to your skin, there is *no need to panic*. Not all ticks are infected, and studies of infected deer ticks have shown that they begin transmitting Lyme disease an average of 36 to 48 hours after

attachment.Therefore, your chances of contracting LD are greatly reduced if you remove a tick within the first 48 hours. Remember, too, that nearly all of early diagnosed Lyme disease cases are easily treated and cured.

To remove a tick, follow these steps:

1. Using a pair of pointed precision* tweezers, grasp the tick by the head or mouthparts right where they enter the skin. **DO NOT** grasp the tick by the body.
2. Without jerking, pull firmly and steadily directly outward. **DO NOT** twist the tick out or apply petroleum jelly, a hot match, alcohol or any other irritant to the tick in an attempt to get it to back out.
3. Place the tick in a vial or jar of alcohol to kill it.
4. Clean the bite wound with disinfectant.

*Keep in mind that certain types of fine-pointed tweezers, especially those that are etched, or rasped, at the tips, may not be effective in removing nymphal deer ticks. Choose unrasped fine-pointed tweezers whose tips align tightly when pressed firmly together.

Then, monitor the site of the bite for the appearance of a rash beginning 3 to 30 days after the bite. At the same time, learn about the other early symptoms of Lyme disease and watch to see if they appear in about the same timeframe. If a rash or other early symptoms develop, see a physician immediately.

Finally, prevention is not limited to personal precautions. Those who enjoy spending time in their yards can reduce the tick population around the home by:

- keeping lawns mowed and edges trimmed
- clearing brush, leaf litter and tall grass around houses and at the edges of gardens and open stone walls
- stacking woodpiles neatly in a dry location and preferably off the ground
- clearing all leaf litter (including the remains of perennials) out of the garden in the fall

- having a licensed professional spray the residential environment (only the areas frequented by humans) with an insecticide in late May (to control nymphs) and optionally in September (to control adults).

Lyme disease

From Wikipedia, the free encyclopedia

Lyme Disease

Classification and external resources

Nymphal and adult deer ticks can be carriers of Lyme disease. Nymphs are about the size of a poppy seed.

ICD-10	A69.2
ICD-9	088.81
DiseasesDB	1531

MedlinePlus	001319
eMedicine	med/1346 ped/1331 neuro/521 emerg/588
MeSH	D008193

Lyme disease, or **lyme borreliosis**,[1] is an emerging infectious disease caused by at least three species of bacteria belonging to the genus *Borrelia*.[2][3] *Borrelia burgdorferi sensu stricto*[4] is the main cause of Lyme disease in the United States, whereas *Borrelia afzelii* and *Borrelia garinii* cause most European cases. The disease is named after the town of Lyme, Connecticut, USA, where a number of cases were identified in 1975. Although Allen Steere realized in 1978 that Lyme disease was a tick-borne disease, the cause of the disease remained a mystery until 1981, when *B. burgdorferi* was identified by Willy Burgdorfer.

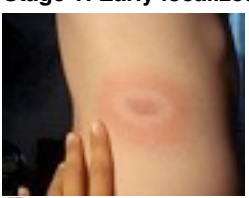
Lyme disease is the most common tick-borne disease in the Northern Hemisphere. *Borrelia* is transmitted to humans by the bite of infected ticks belonging to a few species of the genus *Ixodes* ("hard ticks").[5] Early symptoms may include fever, headache, fatigue, depression, and a characteristic circular skin rash called erythema migrans. Left untreated, later symptoms may involve the joints, heart, and central nervous system. In most cases, the infection and its symptoms are eliminated by antibiotics, especially if the illness is treated early.[6] Delayed or inadequate treatment can lead to the more serious symptoms, which can be disabling and difficult to treat.[7] Lyme disease is a biosafety level 2 disease.

Contents

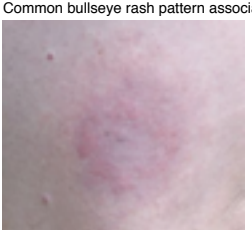
Signs and symptoms

Lyme disease can affect multiple body systems and produce a range of symptoms. Not all patients with Lyme disease will have all symptoms, and many of the symptoms are not specific to Lyme disease but can occur with other diseases as well. The incubation period from infection to the onset of symptoms is usually one to two weeks, but can be much shorter (days), or much longer (months to years). Symptoms most often occur from May through September, because the nymphal stage of the tick is responsible for most cases.[8] Asymptomatic infection exists, but occurs in less than 7% of infected individuals in the United States.[9] Asymptomatic infection may be much more common among those infected in Europe.[10]

Stage 1: Early localized infection



Common bullseye rash pattern associated with Lyme disease



Characteristic "bulls-eye" rash caused by Lyme disease

The classic sign of early local infection with Lyme disease is a circular, outwardly expanding rash called erythema chronicum migrans (also erythema migrans or EM), which occurs at the site of the tick bite three to thirty days after the tick bite.[11][12] The rash is red, and may be warm, but is generally painless. Classically, the innermost portion remains dark red and becomes indurated; the outer edge remains red; and the portion in between clears, giving the appearance of a bullseye. However, partial clearing is uncommon, and the bullseye pattern more often involves central redness.[13]

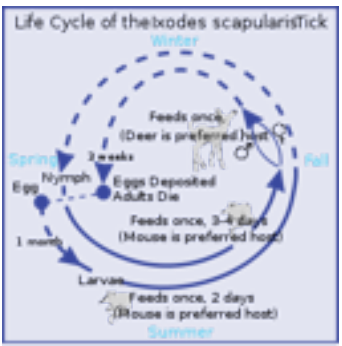
Erythema migrans is thought to occur in about 80% of infected patients.[12] Patients can also experience flu-like symptoms such as headache, muscle soreness, fever, and malaise.[14] Lyme disease can progress to later stages even in patients who do not develop a rash.[15]

Stage 2: Early disseminated infection

Within days to weeks after the onset of local infection, the borrelia bacteria may begin to spread through the bloodstream. Erythema chronicum migrans may develop at sites across the body that bear no relation to the original tick bite.[16] Another skin condition, which is apparently absent in North American patients but occurs in Europe, is borrelial lymphocytoma, a purplish lump that develops on the ear lobe, nipple, or scrotum.[17] Other discrete symptoms include migrating pain in muscles, joint, and tendons, and heart palpitations and dizziness caused by changes in heartbeat.

Various acute neurological problems, termed neuroborreliosis, appear in 10–15% of untreated patients.[14][18] These include facial palsy, which is the loss of muscle tone on one or both sides of the face, as well as meningitis, which involves severe headaches, neck stiffness, and sensitivity to light. Radiculoneuritis causes shooting pains that may interfere with sleep as well as abnormal skin sensations. Mild encephalitis may lead to memory loss, sleep disturbances, or mood changes. In addition, some case reports have described altered mental status as the only symptom seen in a few cases of early neuroborreliosis.[19]

Stage 3: Late persistent infection



Deer tick life cycle

After several months, untreated or inadequately treated patients may go on to develop severe and chronic symptoms that affect many parts of the body, including the brain, nerves, eyes, joints and heart. Myriad disabling symptoms can occur, including permanent paraplegia in the most extreme cases.[20]

Chronic neurologic symptoms occur in up to 5% of untreated patients.[14] A polyneuropathy that involves shooting pains, numbness, and tingling in the hands or feet may develop. A neurologic syndrome called Lyme encephalopathy is associated with subtle cognitive problems, such as difficulties with concentration and short-term memory. These patients may also experience profound fatigue.[21] However, other problems such as depression and fibromyalgia are no more common in people who have been infected with Lyme than in the general population.[21][22] Chronic encephalomyelitis, which may be progressive, can involve cognitive impairment, weakness in the legs, awkward gait, facial palsy, bladder problems, vertigo, and back pain. In rare cases untreated Lyme disease may cause frank psychosis, which has been mis-diagnosed as schizophrenia or bipolar disorder. Panic attack and anxiety can occur, also delusional behavior, including somatoform delusions, sometimes accompanied by a depersonalization

or derealization syndrome, where the person begins to feel detached from themselves or from reality.[23][24]

Diffuse white matter pathology can disrupt grey matter connections, and could account for deficits in attention, memory, visuospatial ability, complex cognition, and emotional status. White matter disease may have a greater potential for recovery than gray matter disease, perhaps because neuronal loss is less common. Resolution of MRI white matter hyper-intensities after antibiotic treatment has been observed.[25]

Lyme arthritis usually affects the knees.[26] In a minority of patients arthritis can occur in other joints, including the ankles, elbows, wrist, hips, and shoulders. Pain is often mild or moderate, usually with swelling at the involved joint. Baker's cysts may form and rupture. In some cases joint erosion occurs.

Acrodermatitis chronica atrophicans (ACA) is a chronic skin disorder observed primarily in Europe among the elderly.[17] ACA begins as a reddish-blue patch of discolored skin, often on the backs of the hands or feet. The lesion slowly atrophies over several weeks or months, with the skin becoming first thin and wrinkled and then, if untreated, completely dry and hairless.[27]

Cause

Main article: Lyme disease microbiology

Borrelia bacteria, the causative agent of Lyme disease. Magnified 400 times.

Ixodes scapularis, the primary vector of Lyme disease in eastern North America.

Lyme disease is caused by Gram-negative spirochetal bacteria from the genus *Borrelia*. At least 11 *Borrelia* species have been discovered, 3 of which are known to be Lyme-related.[28][29] The *Borrelia* species that cause Lyme disease are collectively known as *Borrelia burgdorferi sensu lato*, and show a great deal of genetic diversity.[30]

The group *Borrelia burgdorferi sensu lato* is made up of three closely related species that are probably responsible for the large majority of cases: *B. burgdorferi sensu stricto* (predominant in North America, but also present in Europe), *B. afzelii*, and *B. garinii* (both predominant in Eurasia).[28] Some studies have also proposed that *B. bissettii* and *B. valaisiana* may sometimes infect humans, but these species do not seem to be important causes of disease.[31][32]

Transmission

Lyme disease is classified as a zoonosis, as it is transmitted to humans from a natural reservoir among rodents by ticks that feed on both sets of hosts.[33] Hard-bodied ticks of the genus *Ixodes* are the main vectors of Lyme disease.[3] Most infections are caused by ticks in the nymphal stage, as they are very small and may feed for long periods of time undetected.[33] Larval ticks are very rarely infected.[34] Tick bites often go unnoticed because of the small size of the tick in its nymphal stage, as well as tick secretions that prevent the host from feeling any itch or pain from the bite. However, transmission is quite rare, with only about 1% of recognized tick bites resulting in Lyme disease; this may be due to the fact that an infected tick must be attached for at least a day for transmission to occur.[35]

In Europe the vector is *Ixodes ricinus*, which is also called the sheep tick or castor bean tick.[36] In China *Ixodes persulcatus* (the taiga tick) is probably the most important vector.[37] In North America, the black-legged tick or deer tick (*Ixodes scapularis*) is the main vector on the east coast.[34] The lone star tick (*Amblyomma americanum*), which is found throughout the Southeastern United States as far west as Texas, is unlikely to transmit the Lyme disease spirochete *Borrelia burgdorferi*,[38] though it may be implicated in a related syndrome called southern tick-associated rash illness, which resembles a mild form of Lyme disease.[39] On the West Coast of the United States, the main vector is the western black-legged tick (*Ixodes pacificus*).[40] The tendency of this tick species to feed predominantly on host species such as lizards that are resistant to *Borrelia* infection appears to diminish transmission of Lyme disease in the West.[41][42]

While Lyme spirochetes have been found in insects as well as ticks,[43] reports of actual infectious transmission appear to be rare.[44] Lyme spirochetes have been found in semen[45] and breast milk,[46] and transmission, although rare, has been known to take place through sexual contact.[47] Transmission across the placenta during pregnancy has not been demonstrated, and no consistent pattern of teratogenicity or specific "congenital Lyme borreliosis" has been identified. As with a number of other spirochetal diseases, adverse pregnancy outcomes are possible with untreated infection; prompt treatment with antibiotics reduces or eliminates this risk.[48][49] Pregnant Lyme-disease patients cannot be treated with the first-choice antibiotic, doxycycline (see below), as it is potentially harmful for the fetus. Instead, erythromycin is usually given; it is less effective against the disease but harmless for the fetus.[48]

Tick-borne co-infections

Ticks that transmit *B. burgdorferi* to humans can also carry and transmit several other parasites such as *Theileria microti* and *Anaplasma phagocytophilum*, which cause the diseases babesiosis and human granulocytic anaplasmosis (HGA), respectively.[50] Among early Lyme disease patients, depending on their location, 2–12% will also have HGA and 2–40% will have babesiosis.[51] Ticks in certain regions, including the landscapes along the Eastern Baltic Sea, also transmit *tick-borne encephalitis*.[52]

Co-infections complicate Lyme symptoms, especially diagnosis and treatment. It is possible for a tick to carry and transmit one of the co-infections and not *Borrelia*, making diagnosis difficult and often elusive. The Centers for Disease Control studied 100 ticks in rural New Jersey and found that 55% of the ticks were infected with at least one of the pathogens.[53]

Pathophysiology

Borrelia burgdorferi can spread throughout the body during the course of the disease and has been found in the skin, heart, joint, peripheral nervous system, and central nervous system.[54][55] Many of the signs and symptoms of Lyme

disease are a consequence of the immune response to the spirochete in those tissues.[14]

B. burgdorferi is injected into the skin by the bite of an infected *Ixodes* tick. Tick saliva, which accompanies the spirochete into the skin during the feeding process, contains substances that disrupt the immune response at the site of the bite.[56] This provides a protective environment where the spirochete can establish infection. The spirochetes multiply and migrate outward within the dermis. The host inflammatory response to the bacteria in the skin causes the characteristic circular EM lesion.[54] However neutrophils, which are necessary to eliminate the spirochetes from the skin, fail to appear in the developing EM lesion. This allows the bacteria to survive and eventually spread throughout the body.[57]

Days to weeks following the tick bite, the spirochetes spread via the bloodstream to joints, heart, nervous system, and distant skin sites, where their presence gives rise to the variety of symptoms of disseminated disease. The spread of *B. burgdorferi* is aided by the attachment of the host protease plasmin to the surface of the spirochete.[58] If untreated, the bacteria may persist in the body for months or even years, despite the production of anti-*B. burgdorferi* antibodies by the immune system.[35] The spirochetes may avoid the immune response by decreasing expression of surface proteins that are targeted by antibodies, antigenic variation of the VlsE surface protein, inactivating key immune components such as complement, and hiding in the extracellular matrix, which may interfere with the function of immune factors.[59][60]

In the brain *B. burgdorferi* may induce astrocytes to undergo astrogliosis (proliferation followed by apoptosis), which may contribute to neurodysfunction.[61] The spirochetes may also induce host cells to secrete products toxic to nerve cells, including quinolinic acid and the cytokines IL-6 and TNF-alpha, which can produce fatigue and malaise.[62][63][64] Both microglia and astrocytes secrete IL-6 and TNF-alpha in the presence of the spirochete.[61][65] This cytokine response may contribute to cognitive impairment.[66]

A developing hypothesis is that the chronic secretion of stress hormones as a result of *Borrelia* infection may reduce the effect of neurotransmitters, or other receptors in the brain by cell-mediated pro-inflammatory pathways, thereby

leading to the dysregulation of neurohormones, specifically glucocorticoids and catecholamines, the major stress hormones.[67][68] This process is mediated via the hypothalamic-pituitary-adrenal axis. Additionally tryptophan, a precursor to serotonin appears to be reduced within the central nervous system (CNS) in a number of infectious diseases that affect the brain, including Lyme.[69] Researchers are investigating if this neurohormone secretion is the cause of neuropsychiatric disorders developing in some patients with borreliosis.[70]

Immunological studies

It is possible that exposure to the *Borrelia* bacterium during Lyme disease causes a long-lived and damaging inflammatory response.[71] This would be a form of pathogen-induced autoimmune disease.[72] The production of this reaction might be due to a form of molecular mimicry, where *Borrelia* avoid being killed by the immune system by resembling normal parts of the body's tissues.[73][74] It is therefore possible that if some chronic symptoms come from an autoimmune reaction, this could explain why some symptoms persist even after the spirochetes have been eliminated from the body. This hypothesis may explain chronic arthritis that persists after antibiotic therapy, similar to rheumatic fever, but its wider application is controversial.[75][76]

Diagnosis

Lyme disease is diagnosed clinically based on symptoms, objective physical findings (such as erythema migrans, facial palsy, or arthritis), a history of possible exposure to infected ticks, as well as serological blood tests. When making a diagnosis of Lyme disease, health care providers should consider other diseases that may cause similar illness. Most but not all patients with Lyme disease will develop the characteristic bulls-eye rash, but many may not recall a tick bite.[77] Laboratory testing is not recommended for persons who do not have symptoms of Lyme disease.

Because of the difficulty in culturing *Borrelia* bacteria in the laboratory, diagnosis of Lyme disease is typically based on the clinical exam findings and a history of exposure to endemic Lyme areas.[3] The EM rash, which does not occur in all

cases, is considered sufficient to establish a diagnosis of Lyme disease even when serologic blood tests are negative.[78][79] Serological testing can be used to support a clinically suspected case but is not diagnostic by itself.[3]

Diagnosis of late-stage Lyme disease is often complicated by a multi-faceted appearance and non-specific symptoms, prompting one reviewer to call Lyme the new "great imitator."[80] Lyme disease may be misdiagnosed as multiple sclerosis, rheumatoid arthritis, fibromyalgia, chronic fatigue syndrome (CFS), lupus, Crohn's disease or other autoimmune and neurodegenerative diseases.

Laboratory testing

Several forms of laboratory testing for Lyme disease are available, some of which have not been adequately validated. The most widely used tests are serologies, which measure levels of specific antibodies in a patient's blood. These tests may be negative in early infection, as the body may not have produced a significant quantity of antibodies, but they are considered a reliable aid in the diagnosis of later stages of Lyme disease.[81]

The serological laboratory tests most widely available and employed are the Western blot and ELISA. A two-tiered protocol is recommended by the CDC: the sensitive ELISA test is performed first, and if it is positive or equivocal then the more specific Western blot is run.[82] The reliability of testing in diagnosis remains controversial,[3] however studies show the Western blot IgM has a specificity of 94–96% for patients with clinical symptoms of early Lyme disease.[83][84] The initial ELISA test has a sensitivity of about 70%, and in two tiered testing the overall sensitivity is only 64% although this rises to 100% in the subset of people with disseminated symptoms, such as arthritis.[85] However, ELISA testing is typically done against region specific epitopes and may report a false negative if the patient has been infected with Borrelia from another region than that in which they are tested.[86]

Erroneous test results have been widely reported in both early and late stages of the disease. These errors can be caused by several factors, including antibody cross-reactions from other infections including Epstein-Barr virus and cytomegalovirus,[87] as well as herpes simplex virus.[88] The overall rate of false

positives is low, only about 1 to 3%, in comparison to a false negative rate of up to 36% using two tiered testing.[85]

Polymerase chain reaction (PCR) tests for Lyme disease have also been developed to detect the genetic material (DNA) of the Lyme disease spirochete. PCR tests are susceptible to false-positive results from poor laboratory technique.[89] Even when properly performed, PCR often shows false-negative results with blood and CSF specimens.[90] Hence PCR is not widely performed for diagnosis of Lyme disease. However PCR may have a role in diagnosis of Lyme arthritis because it is a highly sensitive way of detecting *ospA* DNA in synovial fluid.[91] With the exception of PCR, there is currently no practical means for detecting the presence of the organism, as serologic studies only test for antibodies of *Borrelia*. High titers of either immunoglobulin G (IgG) or immunoglobulin M (IgM) antibodies to *Borrelia* antigens indicate disease, but lower titers can be misleading. This is because the IgM antibodies may remain after the initial infection, and IgG antibodies may remain for years.[92]

Western blot, ELISA and PCR can be performed by either blood test via venipuncture or cerebrospinal fluid (CSF) via lumbar puncture. Though lumbar puncture is more definitive of diagnosis, antigen capture in the CSF is much more elusive; reportedly CSF yields positive results in only 10–30% of patients cultured. The diagnosis of neurologic infection by *Borrelia* should not be excluded solely on the basis of normal routine CSF or negative CSF antibody analyses.[93]

New techniques for clinical testing of *Borrelia* infection have been developed, such as LTT-MELISA,[94] although the results of studies are contradictory and there is no study assessing the diagnostic sensitivity and specificity of the test.[95] Others, such as *focus floating microscopy*, are under investigation.[96] New research indicates chemokine CXCL13 may also be a possible marker for neuroborreliosis.[97]

Some laboratories offer Lyme disease testing using assays whose accuracy and clinical usefulness have not been adequately established. These tests include urine antigen tests, PCR tests on urine, immunofluorescent staining for cell wall-deficient forms of Borrelia burgdorferi, and lymphocyte transformation tests. The CDC does not recommend these tests and a 2005 review by Aguero-Rosenfeld

et al. in *Clinical Microbiology Reviews* stated that their use is "of great concern and is strongly discouraged".[90]

In addition to laboratory testing on patients, ticks can be tested after removal from the host. Several laboratories perform PCR testing on live or dead ticks for a panel of tick-borne diseases including *Borrelia*, Babesia, and Ehrlichia.[98]

Imaging

Neuroimaging does not provide specific patterns unique to neuroborreliosis, but may aid in differential diagnosis and in understanding the pathophysiology of the disease.[99]

MRI scans of patients with neurologic Lyme disease may demonstrate punctuated white matter lesions on T2-weighted images, similar to those seen in demyelinating or inflammatory disorders such as multiple sclerosis, systemic lupus erythematosus (SLE), or cerebrovascular disease.[100]

Cerebral hypoperfusion of frontal subcortical and cortical structures has been reported.[101] In about 70% of patients with cognitive symptoms caused by neuropsychiatric Lyme disease,[102] single photon emission computed tomography (SPECT) imaging reveals a pattern of global hypoperfusion in a heterogeneous distribution through the white matter.[102][103] This pattern is similar to that observed in other central nervous system (CNS) syndromes, such as HIV encephalopathy, viral encephalopathy, chronic cocaine use, and vasculitides.

Prevention

Attached ticks should be removed promptly, as removal within 36 hours can reduce transmission rates.[104] Protective clothing includes a hat and long-sleeved shirts and long trousers that are tucked into socks or boots. Light-colored clothing makes the tick more easily visible before it attaches itself. People should use special care in handling and allowing outdoor pets inside homes because they can bring ticks into the house.

A more effective, communitywide method of preventing Lyme disease is to reduce the numbers of primary hosts on which the deer tick depends, such as rodents, other small mammals, and deer. Reduction of the deer population may over time help break the reproductive cycle of the deer ticks and their ability to flourish in suburban and rural areas.[105]

An unusual, organic approach to control of ticks and prevention of Lyme disease involves the use of domesticated guineafowl. Guineafowl are voracious consumers of insects and arachnids and have a particular fondness for ticks. Localized use of domesticated guineafowl may reduce dependence on chemical pest-control methods.[106]

Management of host animals

Lyme and all other deer-tick-borne diseases can be prevented on a regional level by reducing the deer population that the ticks depend on for reproductive success. This has been demonstrated in the communities of Monhegan, Maine [107] and in Mumford Cove, Connecticut.[108] The black-legged or deer tick (*Ixodes scapularis*) depends on the white-tailed deer for successful reproduction.

For example, in the US, it is suggested that by reducing the deer population to levels of 8 to 10 per square mile (from the current levels of 60 or more deer per square mile in the areas of the country with the highest Lyme disease rates), the tick numbers can be brought down to levels too low to spread Lyme and other tick-borne diseases.[109] However, such a drastic reduction may be impractical in many areas.

Vaccination

A recombinant vaccine against Lyme disease, based on the outer surface protein A (OspA) of *B. burgdorferi*, was developed by GlaxoSmithKline. In clinical trials involving more than 10,000 people, the vaccine, called LYMErix, was found to confer protective immunity to *Borrelia* in 76% of adults and 100% of children with only mild or moderate and transient adverse effects.[110] LYMErix was approved on the basis of these trials by the U.S. Food and Drug Administration (FDA) on December 21, 1998.

Following approval of the vaccine, its entry in clinical practice was slow for a variety of reasons including its cost, which was often not reimbursed by insurance companies.[111] Subsequently, hundreds of vaccine recipients reported that they had developed autoimmune side effects. Supported by some patient advocacy groups, a number of class-action lawsuits were filed against GlaxoSmithKline alleging that the vaccine had caused these health problems. These claims were investigated by the FDA and the U.S. Centers for Disease Control (CDC), who found no connection between the vaccine and the autoimmune complaints.[112]

Despite the lack of evidence that the complaints were caused by the vaccine, sales plummeted and LYMErix was withdrawn from the U.S. market by GlaxoSmithKline in February 2002,[113] in the setting of negative media coverage and fears of vaccine side effects.[112][114] The fate of LYMErix was described in the medical literature as a "cautionary tale";[114] an editorial in *Nature* cited the withdrawal of LYMErix as an instance in which "unfounded public fears place pressures on vaccine developers that go beyond reasonable safety considerations."[115] The original developer of the OspA vaccine at the Max Planck Institute told *Nature*: "This just shows how irrational the world can be... There was no scientific justification for the first OspA vaccine LYMErix being pulled."[112]

New vaccines are being researched using outer surface protein C (OspC) and glycolipoprotein as methods of immunization.[116][117] Vaccines are available for dogs.[118]

Tick removal

Folk remedies for tick removal tend to be ineffective, offer no advantages in preventing the transfer of disease, and may increase the risks of transmission or infection. The best method is simply to pull the tick out with tweezers as close to the skin as possible, without twisting, and avoiding crushing the body of the tick or removing the head from the body.[119] The risk of infection increases with the time that a tick is attached and if a tick is attached for less than 24 hours infection is unlikely. However, since these ticks are very small, especially in the nymph stage, this makes such prompt detection quite difficult.[104]

Treatment

Antibiotics are the primary treatment for Lyme disease; the most appropriate antibiotic treatment depends upon the patient and the stage of the disease.[3] According to the Infectious Diseases Society of America (IDSA) guidelines, the antibiotics of choice are doxycycline (in adults), amoxicillin (in children), erythromycin (for pregnant women) and ceftriaxone, with treatment lasting 10 to 28 days.[120] Alternative choices are cefuroxime and cefotaxime.[3] Treatment of pregnant women is similar, but tetracycline should not be used.[120]

A double blind, randomized, placebo-controlled multicenter clinical study indicated that 3 weeks of treatment with intravenous ceftriaxone, followed by 100 days of treatment with oral amoxicillin did not improve symptoms any more than just 3 weeks of treatment with ceftriaxone. The researchers noted that the outcome should not be evaluated after the initial antibiotic treatment but rather 6–12 months afterwards. In patients with chronic post-treatment symptoms, persistent positive levels of antibodies did not seem to provide any useful information for further care of the patient.[121]

In later stages, the bacteria disseminate throughout the body and may cross the blood-brain barrier, making the infection more difficult to treat. Late diagnosed Lyme is treated with oral or intravenous antibiotics, frequently ceftriaxone for a minimum of four weeks. Minocycline is also indicated for neuroborreliosis for its ability to cross the blood-brain barrier.[122]

Post-Lyme disease symptoms and chronic Lyme disease

The term "chronic Lyme disease" is often applied to several different sets of patients. One usage refers to people suffering from the symptoms of untreated and disseminated late-stage Lyme disease: arthritis, peripheral neuropathy and/or encephalomyelitis. The term is also applied to people who have had the disease in the past and some symptoms remain after antibiotic treatment, which is also called post-Lyme disease syndrome. A third and controversial use of the

term applies to patients with non-specific symptoms such as fatigue who show no objective evidence that they have been infected with Lyme disease in the past, since the standard diagnostic tests for infection are negative.[6][123]

Up to one third of Lyme disease patients who have completed a course of antibiotic treatment continue to have symptoms such as severe fatigue, sleep disturbance, and cognitive difficulties, with these symptoms being severe in about 2% of cases.[7][124] While it is undisputed that these patients can have severe symptoms, the cause of these symptoms and appropriate treatment is controversial. The symptoms may represent "for all intents and purposes" fibromyalgia or chronic fatigue syndrome.[125] A few doctors[*who?*] attribute these symptoms to persistent infection with *Borrelia*, or coinfections with other tick-borne infections such as *Ehrlichia* and *Babesia*.[126][127] Other doctors believe that the initial infection may cause an autoimmune reaction that continues to cause serious symptoms even after the bacteria have been eliminated by antibiotics.[71]

Four randomized controlled trials have been performed in patients who have persisting complaints and a history of *Borrelia* infection. Some of these patients had evidence of an ongoing *Borrelia* infection and almost all of them were previously treated with antibiotics. The authors of all four trials concluded that their results did not support long-term antibiotic therapy:

- Two studies showed no benefit from 30 days of intravenous ceftriaxone and 60 days of oral doxycycline, concluding that "treatment with intravenous and oral antibiotics for 90 days did not improve symptoms more than placebo".[128][129]
- One study showed an improvement only in fatigue after 28 days of intravenous antibiotics, an effect that was significant only in a group of patients that never had antibiotics previously.[130] The results may have been compromised by unblinding, and detected a large placebo effect.[131] This trials also saw several cases of life-threatening side effects, concluding that "repeated courses of antibiotic treatment are not indicated for persistent symptoms following Lyme disease including those related to fatigue and cognitive dysfunction, particularly in light of the frequency of serious adverse events."

- One study reported an improvement in fatigue in a subset of patients and a transient improvement in cognition after 10 weeks of intravenous antibiotics, but concluded that the treatment was "not an effective strategy for sustained cognitive improvement."[132][133] These patients had also been ill for many years and had taken many antibiotic courses. Also, this study performed ad hoc statistical analysis[134] and its results were questionably significant.[124]

A non-profit interest group called the International Lyme And Associated Diseases Society (ILADS)[135] argues that persistence of B. burgdorferi may be responsible for manifestations of late Lyme disease symptoms.[136] It has questioned the generalizability and reliability of some of the above trials and the reliability of the current diagnostic tests.[127][136][137] Major US medical authorities, including the Infectious Diseases Society of America, the American Academy of Neurology, and the National Institutes of Health, have stated that there is no convincing evidence that *Borrelia* is involved in the various symptoms classed as chronic Lyme disease, and advise against long-term antibiotic treatment as ineffective and possibly harmful.[123][138][139][140] There are significant side effects and risks of prolonged antibiotic therapy, and one death has been reported from complications of a 27-month course of intravenous antibiotics for an unsubstantiated diagnosis of chronic Lyme disease.[141]

Antibiotic treatment is the central pillar in the management of Lyme disease. However, in the late stages of borreliosis, symptoms may persist despite extensive and repeated antibiotic treatment.[142] Although it is possible that these chronic symptoms are due to either autoimmunity or residual bacteria (see immunological studies below), no *Borrelia* DNA can usually be detected in the joints after antibiotic treatment, which suggests that the arthritis may continue even after the bacteria have been killed.[71] Lyme arthritis that persists after antibiotic treatment may be treated with hydroxychloroquine or methotrexate.[143] Corticosteroid injections into the affected joint are not recommended for any stage of Lyme arthritis.[144]

Patients with chronic neuropathic pain responded well to gabapentin monotherapy with residual pain after intravenous ceftriaxone treatment in a pilot study.[145] Some antibiotics may have a dual effect on Lyme disease, since

minocycline and doxycycline have anti-inflammatory effects in addition to their antibiotic actions including anti-inflammatory effects specific to the inflammation caused by Lyme Disease.[146][147] Indeed, minocycline is used in other neurodegenerative and inflammatory disorders such as multiple sclerosis, Parkinson's disease, Huntington's disease, rheumatoid arthritis (RA) and ALS.[148]

Controversy and politics

While there is general agreement on the optimal treatment of early Lyme disease, there is considerable controversy over the existence, prevalence, diagnostic criteria, and treatment of chronic Lyme disease.[135][149] The mainstream view is exemplified by a 2007 review in the *New England Journal of Medicine*, which noted that the diagnosis of chronic Lyme disease is used by a few physicians[*who?*] despite a lack of "reproducible or convincing scientific evidence," leading the authors to describe this diagnosis as "the latest in a series of syndromes that have been postulated in an attempt to attribute medically unexplained symptoms to particular infections."[123] Most medical authorities agree with this viewpoint: the Infectious Diseases Society of America (IDSA), the American Academy of Neurology, the U.S. Centers for Disease Control, and the National Institutes of Health advise against long-term antibiotic treatment for chronic Lyme disease, given the lack of supporting evidence and the potential toxicities.[138][139][140]

A minority view holds that chronic Lyme disease is responsible for a range of unexplained symptoms, sometimes in people without any evidence of past infection.[149] This viewpoint is promoted by many patient advocates, notably an advocacy organization[135] called the International Lyme And Assoc