

LYME DISEASE

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Lyme Disease has received a great deal of publicity recently. In the US there is so much widespread concern that the government spends a great deal of money on Lyme Disease research – second only to the amount that is spent investigating AIDS! So where did this disease suddenly appear from and just how worried should people in Scotland be?

History:

Lyme Disease was probably first noticed in Germany in 1883 when a physician called Buchwald described an unusual skin rash (later to be called *erythema migrans*) which occurred after a tick bite. This sparked off a number of other reports of patients who had started off with the same characteristic skin rash following a tick bite, but who had then gone on to develop a vast and confusing range of symptoms. For years debate raged as to the cause of this mysterious illness – was it caused by a toxin injected by the ticks or was this an infectious disease passed on by ticks? The answer came in the 1940s with the development of penicillin. Many patients who were given the antibiotic experienced a dramatic improvement in their symptoms, a fact which suggested that the disease was due to a bacterium, although the type of bacterium remained a puzzle.

This strange condition remained exclusively a fairly rare European problem until the late 1960s when the first few cases were recorded in the U.S. However, everything changed in 1975 when a mini-epidemic of arthritis occurred around the town of Old Lyme in Connecticut. A massive investigation was launched and it was found that all of the people affected had suffered a tick bite with the characteristic skin rash (*erythema migrans*) at the start of the illness, before the arthritis began. However, because arthritis was a very rare symptom in the disease described for so many years in Europe, it was thought that this might be a totally new condition and so the name Lyme Disease was created – after the town where the problem was first noticed.

The cause of this disease was discovered by complete accident in 1981. The physician, Willy Bugdorfer, was investigating another American tick-borne disease called Rocky Mountain Spotted Fever. He noticed some large spiral filaments in the mid-gut of two female *Ixodes dammini* ticks, which turned out to be bacteria, and managed to grow them in the laboratory. These spiral bacteria or spirochetes, were found to be previously unknown members of a family of bacteria called *Borrelia* and the name *Borrelia Bugdorferi* was devised

for them. Further study showed that these bacteria were responsible for both the American tick-borne epidemic of arthritis and also its familiar European counterpart. Thus, nearly a 100 years after it was initially described, the cause of this strange condition was finally found and both the European and American diseases were referred to as Lyme Disease.

Tick Vectors and Hosts:

The discovery of *B. Bugdorferi* allowed the development of commercial diagnostic kits and Lyme Disease has now been reported from all five continents. Although other ticks or even flies may transmit the disease in some areas, the usual carriers or vectors, are now known to be the small hard-bodied ticks of the genus *Ixodes* which carry the bacterium *B. Bugdorferi* in their mid-gut without suffering any problems themselves. The most common vector of Lyme Disease in Europe is the species *Ixodes ricinus*. Other *Ixodes* ticks are also found in Scotland, including *I. hexagonous*, *I. canisuga*, *I. uriae* and *I. trianguliceps*, but these do not feature in the transmission of Lyme Disease simply because they do not bite humans. *I. ricinus*, also known as the common sheep tick, has no such qualms and will bite anything available.

As with many other infectious diseases where insect vectors such as ticks are important, the biology of *B. Bugdorferi* is now known to be complex. Although these bacteria can produce disease in many animals, some mammals such as mice can have *B. Bugdorferi* in their blood for many months without any ill effect – thus they are known as reservoirs. *Ixodes* ticks have a three-stage-life cycle, larva, nymph and adult, taking a single blood meal during each stage of development (see table). The newly-hatched larvae are very unlikely to have *B. Bugdorferi* in their gut, but if their first meal is from one of the reservoir mammals, bacteria will be introduced into their mid-gut. They will then be able to pass the bacteria to any animal that they subsequently bite, possibly producing another reservoir individual and so maintaining the cycle. However, not all animals are able to act as reservoirs of infection. It appears that humans and some large domestic animals such as cats, dogs, cattle, sheep and horses, *B. Bugdorferi* will be quickly cleared from the blood stream. However, this is at the cost that the animal may suffer the clinical illness of Lyme Disease in the process. More knowledge is rapidly accumulating about this disease. For many years it was thought that humans were the only animals who caught the disease, but it is now accepted that dogs may sometimes suffer from Lyme Disease if bitten by a very large number of ticks. It used to be thought that deer too were reservoirs for the disease in Scotland, but it is now recognised that they are important as the breeding ground for huge numbers of ticks. If deer are removed from a Lyme Disease area the incidence of disease will decrease because a major tick habitat has been removed, not because the deer blood stream is a major reservoir of *B. Bugdorferi* bacteria.

The activity of ticks is dependent largely on climate. Feeding begins with

the onset of warmer weather in early spring and declines during the hotter summer months. A second peak of activity occurs in late summer and early autumn. There is a slight difference in the life cycles of *I. ricinus* on the east and west coasts of Scotland, with the milder climate of the west allowing for a longer period of tick activity both through the summer and the early winter months.

As ticks live in the bracken undergrowth of woodlands and rough grassy pastureland of the Highlands, it is the people in such areas who are at most risk from contracting Lyme Disease. The highest concentration of ticks are found on the edges of little paths and tracks used by small mammals, and are most likely to quest for hosts in the evening when the animals themselves begin to forage for food. Questing ticks travel to the top of grass blades or bracken leaves, anticipating the approaching host. The ticks can sense both heat and carbon dioxide from the advancing animal and prepare to grab on to fur, hair or clothing using fine pincers located on the front pair of legs. When questing, larvae and nymph ticks are typically located at ground level, while adults are normally at knee level. Both usually gain access to human hosts by climbing up the legs as the host brushes by. Ticks cannot jump or fly.

General clinical features:

A feeding tick usually remains attached to its host for a number of days and, even if bitten by a carrier tick, illness is rare if attachment is for less than 24 hours. This is because it takes that long for *B. Burgdorferi* to travel from the tick's mid-gut where it lives, up to the salivary glands from where the bacteria can wriggle into the skin to cause infection.

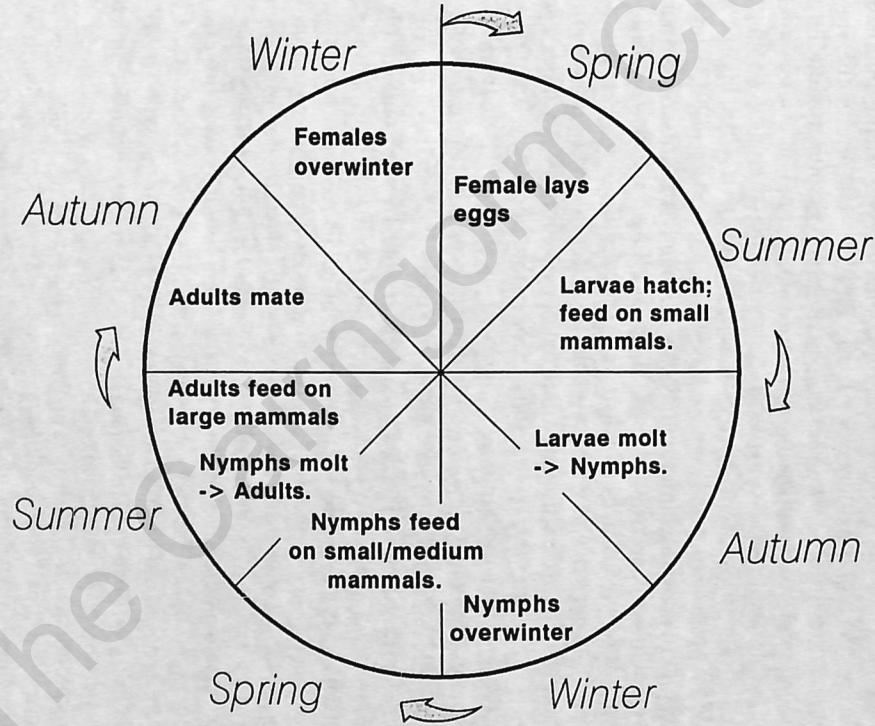
As previously mentioned, Lyme Disease can take so many forms that diagnosis is difficult. The most consistent feature is the skin rash, erythema migrans, which develops around the site of the tick bite. A huge number of different symptoms may then occur weeks or even years later. If the disease was contracted in the US, the most common complaint is usually arthritis. If it was contracted in Europe, the range of symptoms is much broader, although problems with heart or nerves, such as mild meningitis or partial paralysis are particularly well known.

Lyme Disease can be very successfully treated with simple antibiotics such as penicillin, although more expensive drugs may be required for more advanced disease.

Diagnosis:

The presence of erythema migrans is the hallmark symptom of Lyme Disease. It is a large rash surrounding a tick bite, usually 10cm across, but up to 20cm in diameter – especially on the back, with a distinctive line round its outer edges. This should be distinguished from the lumps and bumps which may occur immediately around a tick bite. These are caused by a reaction to the bite itself and do not indicate Lyme Disease. If you suspect that you have

The life cycle of the Ixodid tick.



the erythema migrans rash, you should visit your G.P. **while the rash is still visible**. Once the rash disappears the diagnosis of Lyme Disease is much more difficult as the symptoms can be so diverse.

If further help is needed for diagnosis, a blood sample will be taken and sent to a clinical laboratory. There tests will be performed which will detect antibodies produced by the patient which react with the bacterium *B. Bugdorferi*. Normally, there are none of these antibodies present so if antibodies are found, this is very good evidence for Lyme Disease. Unfortunately, the immune response to *B. Bugdorferi* is frequently quite poor and so antibodies against the bacteria may be difficult to find in some cases.

Prevention:

Modern genetic techniques have shown that Lyme Disease probably has an ancient history, and they also explain why clinical symptoms are so variable. It seems that there are many different strains of *B. Bugdorferi* throughout the world and each one may cause a slightly different sort of infection. The local Scottish ticks are particularly unusual because it has not yet been possible to grow the *B. Bugdorferi* that they carry in the laboratory, even though DNA tests show that the bacteria are present in up to 35% of ticks locally. So, although fortunately less common than in some parts of the US, it is certainly possible to catch Lyme Disease in Scotland.

The prevention of Lyme Disease is straight-forward and simply requires proper dressing to prevent tick attachment. During the warmer months of tick activity (May to September), when in areas likely to harbour ticks such as bracken or old pasture, it is advisable to wear protective clothing, including shoes, long trousers and a long-sleeved shirt. Tucking the trousers into tight-fitting socks worn with boots forms an effective barrier to tick bites. Remember that it needs many hours of tick attachment before infection usually occurs, so check for ticks after working or exercising outside and remove them promptly. The best way to remove a tick is to grasp it firmly with fine tweezers as close to the skin as possible and unscrew it **anti-clockwise**. This ensures complete removal of the tick mouth parts which may otherwise produce an unpleasant boil if broken off into the skin. Squeezing or randomly twisting the tick may cause regurgitation of gut contents into the skin and therefore increases the risk of *B. Bugdorferi* infection. The old-fashioned remedies of smearing the tick with Vaseline, butter, alcohol or nail polish and burning with a cigarette or hot match may not make the tick let go, and may even cause it to regurgitate bacteria in to the skin and so increase the chance of infection.

Scotland is not a particularly high-risk area for Lyme Disease. Remember that this infection can be caught world-wide, so seek medical advice if you develop unusual symptoms after a tick bite.