**Lyme disease: lurking in the bushes**

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**Lyme disease is transmitted via ticks picked up in the undergrowth. It is on the increase and clinicians need to be vigilant and consider it as a diagnosis in patients presenting with cutaneous, neurological, musculoskeletal or cardiac symptoms.**

Although mostly evolving during the Tertiary Period, 65–2.6 million years ago, ticks date back to at least the Cretaceous Period 146–65 million years ago. Ticks have been found in fossilised pieces of amber, as have specimens in which ticks are attached to the feathers of dinosaurs. However, to the author’s knowledge, no work has been done to find out whether fossil ticks contain viral or bacterial nucleic acid. Tick fever is mentioned in an Egyptian scroll dating to 1550 BC. Homer, in about 800 BC, mentions the presence of ticks on Ulysses’ dogs. Hungarian pathologist Viktor Babes described organisms in red blood cells while investigating the cause of febrile haemoglobinuria in cattle - the genus *Babesia* was subsequently named in his honour. Five years later, American scientists Theobald Smith and Fred Kilborne found a similar organism in the blood of Texan cattle and showed that it was transmitted by the cattle tick *Boophilus annulatus*. Ticks are second only to mosquitoes as vectors of human disease (Table 1).

Lyme disease, caused by *Borrelia burgdorferi sensu latu*, is the only tick-borne disease that infects humans in the British Isles. However, cattle and dogs are infected with both *Babesia* and *Anaplasma phagocytophilum*, the cause of human granulocytic anaplasmosis. In theory, humans could also be infected by either of these organisms, both of which are carried by ticks. Cases of babesiosis have been described in Ireland, and the condition is also found in parts of Europe, Asia, Africa and North America, where it is relatively common.

People travelling abroad from the United Kingdom, especially those visiting ‘wild’ areas or trekking, could easily be bitten by a tick and return with a tick-borne illness. Tick-borne disease should be considered in any patient who returns from abroad, including Ireland and Europe, with a febrile illness. It is important to remember that some patients may not remember being bitten by a tick, and also that a tick may be infected with more than one organism that can be transmitted to humans.

**The biology of ticks**

Ticks are arachnids, not insects, and undergo incomplete metamorphosis, passing through a larval and nymphal stage before becoming adults. All stages of tick suck blood, including adult males, and may remain attached to their hosts for days to weeks. Infectious agents can be transmitted at any stage in the tick’s life cycle.

Ticks are classified as either ‘hard’ or ‘soft’. The former type have a sclerotised plate or scutum (a shield) on their back and are the main vectors of tick-borne diseases (Figure 1). All stages of tick live in grassland and bush, often attached to vegetation, while awaiting a suitable host to pass close by.

Mammals such as deer and small rodents, as well as ground-feeding birds, act as reservoir hosts for tick-borne diseases.
In 1883, German physician Alfred Buchwald described a chronic skin disorder which he referred to as atrophia cutis idiopathica diffusa, and was subsequently called acrodermatitis chronica atrophicans. In 1909, dermatologist Arvid Afzelius presented a patient with a slowly expanding skin lesion to a meeting of the Swedish Society of Dermatology in Stockholm. He called the lesion erythema migrans. In 1911, lymphocytoma benigna cutis was described for the first time.

In 1977, North American rheumatologist Allen Steere and his colleagues described a condition in children and young adults in which arthritis was preceded by an annular rash. The patients came from three areas in rural Connecticut: Lyme, Old Lyme and East Haddam. The rash was similar to that of erythema migrans, identified in Europe almost seven decades previously. Five years later, in 1982, entomologist Wilhelm Burgdorfer and his colleagues described the causative organism and showed that it was transmitted by ticks.

Lyme disease is caused by a spirochaete, *Borrelia burgdorferi sensu latu*. In Britain, most cases of Lyme disease are transmitted by ticks of the *Ixodes ricinus* complex. Around 8% of ticks in Britain have been found to be infected by a species of borrelia, though some, such as *B.valeriana*, do not cause disease in humans. The major endemic areas in the UK are the New Forest, Exmoor, the South Downs, Thetford Forest, the Lake District, the North Yorkshire moors and the Scottish Highlands.

Most cases of Lyme disease are associated with outdoor recreational activities such as hiking and camping, or occur in people who live in areas where infected ticks are common. A few cases of occupationally acquired disease are reported each year, usually among forestry workers or people handling deer. A study among forestry workers in the New Forest found that 25% had antibodies to Lyme disease, though none had had symptoms, suggesting that asymptomatic infections may be quite common.

In 2017, 1534 cases of Lyme disease were reported in Britain, 400 more than in the previous year. This may represent a genuine increase in the incidence of Lyme disease, or just increased awareness of the condition. These figures are likely to be an underestimate since Lyme disease is not a notifiable disease.

**Clinical features of Lyme disease**

There are differences between the clinical features of Lyme disease acquired in Europe compared to North America. Clinicians should be aware of this, as about 15% of cases seen in this country are acquired abroad. In Europe, erythema migrans is usually a solitary lesion, whereas multiple lesions are more common in cases acquired in the United States. In European cases, arthritis is rarely preceded by erythema migrans and is usually less severe.

The main clinical features of Lyme disease are associated with the skin, the nervous system, the musculoskeletal system and heart.

**Cutaneous manifestations of Lyme disease**

Erythema migrans, lymphocytoma benigna cutis and acrodermatitis chronica atrophicans are the main cutaneous lesions seen in Lyme disease. Erythema migrans develops at the site of a tick bite, which may not have been noted by the patient, and usually appears within ten days of the bite. The lesion has a homogenous appearance, with a well demarcated border (Figure 2). The periphery is bright red, but as the lesion expands the centre fades in colour. It varies in size from a few inches up to 24 inches. About a third of patients will also have mild

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Table 1. Tick-borne diseases and their causative agents. Only Lyme disease is caught in the British Isles but other diseases may be identified in travellers returning from abroad.
constitutional symptoms such as fatigue and malaise.

Lymphocytoma benigna cutis is a bluish-red tumour-like infiltration of the skin, usually a few centimetres in diameter, which generally appears several weeks after a tick bite. It has a predilection for the lobes of the ear, the helix, the nipple and, in children, the scrotum. It can persist for several months, though it usually heals spontaneously.

Acrodermatitis chronica atrophicans consists of livid red changes in the skin, which usually feels doughy on palpation. The extensor surfaces of the extremities, in particular the leg, are usually involved. Spontaneous healing does not occur. After years of progression, the skin lesions become atrophic and hyperpigmented. Chronic ulceration may develop.

**Joint involvement**
This is uncommon in Lyme disease acquired in Britain. A large joint, usually the knee, is involved. There are no permanent sequelae.

**Neuroborreliosis**
This is a meningoradiculoneuritis that can affect patients of any age. In adults it often presents as radicular pain, which can be severe, together with the paralysis of various nerves, in particular the VII cranial nerve. Pain is worse at night and is not relieved by commonly prescribed analgesics. In children, neuroborreliosis usually presents as aseptic meningitis, VII nerve palsy, or both.

**Cardiac symptoms**
Second- and third-degree heart block can occur in patients with Lyme disease. This may be caused by invasion of the heart by organisms or caused by immune complexes.

**Post-Lyme disease syndromes**
A small number of patients with Lyme disease continue to have non-specific symptoms such as fatigue, musculoskeletal pain and cognitive impairment after treatment. These symptoms can persist for months and appear to be more common in patients who have had the illness for some time before the start of their treatment. Though these symptoms usually resolve, they may sometimes persist in patients despite repeated courses of treatment.

**Diagnosis**
As with so many conditions in medicine, a ‘high index of suspicion’ is important if the correct diagnosis is to be made. Lyme disease should always be considered in patients who suddenly develop cutaneous or neurological symptoms which are not those of a common disease. This is particularly important if the patient has been travelling abroad or is keen on outdoor recreational activities such as camping. It should always be excluded in patients who suddenly develop a facial nerve palsy. NICE recommends antibody testing (ELISA) in cases where Lyme disease is suspected and erythema migrans is not present.¹

**Treatment**
There are national guidelines for the treatment of Lyme disease.¹ Doxycycline (amoxycillin in children under 12) is the treatment of choice for non-neurological forms of Lyme disease and should be given for two weeks. Cefuroxime axetil should be used to treat patients in whom either doxycycline or amoxycillin are contraindicated. Macrolides are a third line option. Azithromycin is the macrolide of choice. Ceftriaxone is used to treat some forms of neuroborreliosis.

**Prevention**
Appropriate precautions should be taken when entering areas likely to be infested with ticks, such as wearing suitable clothing and using repellent. When a tick is removed from the skin, care should be taken to ensure that the mouthparts are removed as well - infection can result if they are left in place. Anyone who is bitten by a tick and who starts to feel unwell or develops signs such as a skin rash, neurological symptoms or arthritis should see their doctor as soon as possible.

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**References**