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Lyme Disease

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Introduction
Lyme disease is caused by the spirochete Borrelia burgdorferi and is a bacterial infectious disease that is spread by zoonotic transmission in which animals act as reservoir hosts and ticks are the primary vector or carrier and are considered arthropods. Transmission to humans may occur following the bite of an infected tick (Parson, 2015). There are two major types of ticks: hard ticks (Ixodes) and soft ticks (Argasid). Hard ticks latch onto their hosts and feed for days, whereas soft ticks usually latch onto their hosts and feed for hours. Noxous soft ticks are usually found in animal nests (Juckett, 2013).

Disease Process
B. burgdorferi is connected to the life cycle of its tick vector. The first meal is during their larval phase during which they seek a host. The nymph phase is the most dangerous since this is the time when the tick is full. If the nymph phase is infected, the spirochetes can be transmitted to the host. The adult phase can also be infected as well. If infected, the nymph will then seek a host which can then transmit the spirochete to the host. The spirochetes can spread to other tissues by entering capillary beds (Bockenstedt, & Wormser, 2014).

Signs and Symptoms
Lyme disease can have different stages with different symptoms in each stage. During the stages of the disease, development of erythema migrans occurs most usually 7-14 days after tick detachment as mentioned previously. Approximately half of patients develop flu-like symptoms including fever, headache, myalgia, stiff neck, and fatigue without gastrointestinal or respiratory symptoms (Nichols & Windmuth, 2013). If Lyme disease is not treated, early disseminated symptoms include neurologic manifestations that can include meningitis, Bell’s palsy, cranial neuritis, and radiculoneuritis. Cardiac manifestations most commonly include atrioventricular block, but patients can experience symptoms of shortness of breath, palpitations, lightheadedness connected to atrioventricular block (Bockenstedt, & Wormser, 2014). Musculoskeletal symptoms such as migratory muscle and joint pain may be present in early untreated disseminated disease (Nichols & Windmuth, 2013).

Underlying Pathophysiology
• The spirochetes may avoid the immune response by decreasing expression of surface proteins that are targeted by antibodies, inactivating key immune components such as complement, and hiding in the extracellular matrix which may interfere with the function of immune cells (Nadelman, 2015).
• The spirochetes spread to other tissues by entering capillary beds (Bockenstedt, & Wormser, 2014).

• Infarction begins when dendritic cells and macrophages respond to Lyme borreliia by pattern-recognition receptors.
• Once these toll-like receptors are stimulated they produce proinflammatory cytokines, including interleukin-1β, tumor necrosis factor a, IL-4, and type I interferons (Bockenstedt, & Wormser, 2014).
• Once the immune system is triggered, local production of CXC13, a B-cell-attracting chemokine produced by monocytes in response to B. burgdorferi outer surface proteins is increased (Halperin, 2014).

• The anti-inflammatory cytokines IL-10 is also produced. The balance between proinflammatory and anti-inflammatory cytokines may determine the efficiency with which cells respond at infected sites and therefore the clinical presentation of the disease (Bockenstedt, & Wormser, 2014).

• If untreated, the bacteria could persist in the body for months or even years, despite antibiotic treatment are called for (Arvikar, Crowley, Sulka, & Steere, 2016). It is important to teach patients the importance of preventing tick bites by spraying clothes with permethrin, a synthetic insecticide, or DEET-containing repellants on clothes, and shoes as well as exposed skin. Tucking pants into socks, wearing hats, and performing a daily tick check also reduce exposure (Jackett, 2013).

• An effective vaccine was developed for Lyme disease, but is no longer available due to not enough people being vaccinated and therefore being cost prohibitive. There is some interesting research being conducted concerning an oral vaccination for wild animal in the United States (Juckett, 2013).

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• Arthritis is the most common late manifestation of Lyme disease and can occur in as much as 60% of patients, in whom infection was not treated at earlier stages, usually developing an average of 6 months after infection. Most patients present with oligoclonal inflammatory arthritis affecting one or more large joints, especially the knee. Children often present with more acute arthritis than adults (Bockenstedt, & Wormser, 2014).

Table 1. The three life stages of the tick against a human thumbnail, (Pearson, 2015).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early localized</td>
<td>Erythema migrans</td>
</tr>
<tr>
<td>Early disseminated</td>
<td>Cardiac (e.g., atrioventricular block)</td>
</tr>
<tr>
<td>Late</td>
<td>Arthritis (r.g., monoarticular, oligoarthropathy)</td>
</tr>
</tbody>
</table>

Figure 1. The three life stages of the tick, against a human thumbnail, (Pearson, 2015).

Implications for Nursing/Future Research
It is important for clinicians to be aware that Lyme disease can cause post-infectious complications such as Lyme arthritis following a Lyme disease course. Even through other infections can trigger autoimmunity, Lyme disease is uniquely characterized by joint manifestations in its late infection and post infectious stages which along with B. burgdorferi, can persist for years after resolution of infection (Arvikar, Crowley, Sulka, & Steere, 2016). This can cause diagnostic confusion, and delay diagnosis and initiation of appropriate anti-inflammatory therapies. When it is found that the patient has Lyme disease-associated autoimmunity responses after antibiotic treatment, disease-modifying antirheumatic drugs or DMARDs, rather than additional antibiotic treatment are called for (Arvikar, Crowley, Sulka, & Steere, 2016). It is important to teach patients the importance of preventing tick bites by spraying clothes with permethrin, a synthetic insecticide, or DEET-containing repellants on clothes, and shoes as well as exposed skin. Tucking pants into socks, wearing hats, and performing a daily tick check also reduce exposure (Jackett, 2013).

Lyme disease is a challenging illness to diagnose correctly. Different patients will present with different signs and symptoms of the disease. Some may have the characteristic erythema migrans rash, but others will not. Vague symptoms like muscle soreness or fatigue and headache can further complicate the diagnosis process. With untreated disease, the most common sites of involvement are the joints, nervous system, and cardiovascular system. Lyme disease is treatable, but some patients struggle with a post Lyme disease syndrome.

Conclusions
Lyme disease is a challenging illness to diagnose correctly. Different patients will present with different signs and symptoms of the disease. Some may have the characteristic erythema migrans rash, but others will not. Vague symptoms like muscle soreness or fatigue and headache can further complicate the diagnosis process. With untreated disease, the most common sites of involvement are the joints, nervous system, and cardiovascular system. Lyme disease is treatable, but some patients struggle with a post Lyme disease syndrome.

References
http://dx.doi.org/10.1002/art.39446
http://dx.doi.org/10.1093/cid/ciu699

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