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Lyme Disease

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Lyme Disease

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Introduction

Lyme disease is the most common vector borne illness found in the United States. Each year 30,000 people are diagnosed with the disease, with many more cases going unreported (Centers for Disease Control and Prevention, 2015). The vector responsible for spreading the disease is the deer tick. The infection itself is caused by the spirochete *Borrelia burgdorferi*. This bacteria is transmitted through the saliva from the bite of a deer tick. Diagnosis can be challenging due to the fact that multiple systems of the body can be affected with different severities. Early diagnosis and treatment is critical in the prevention of progressive and chronic illness.

Lyme disease is a relevant issue of rural Northeast Ohio. The prevalence of the disease is not as common as the high risk areas in the New England states. However, deer ticks can easily be found in any woods close to home. This disease requires more awareness and research within the healthcare community. The pathology of the disease is understood, but details of exactly how *Borrelia burgdorferi* affects certain areas of the body such as the nervous system remains unclear (Halperin, 2014). More importantly physicians and advanced practice nurses in this area need educated on signs and symptoms of the disease so a timely diagnosis can be made. Treatment is simple and complications are preventable with early diagnosis. *Borrelia burgdorferi* has been extensively researched, but more information is needed to fully understand how this bacteria has mastered the ability to evade human immunity (Kenedy, Lenhart, & Akins, 2012).

Disease Process/Signs and Symptoms

The beginning stage in the development of Lyme disease is most recognized as the localized rash called erythema migrans. It is also commonly called "bull's eye rash" due to its physical appearance. The rash forms after about 3-30 days after the tick bite and is around 5 cm in diameter but may spread up to around 30 cm (Pearson, 2015). This early phase of the infection is the easiest time to diagnose the disease when erythema migrans is present. It is the classic symptom of Lyme disease but fades as the individual progresses to the further stages of infection. Erythema migrans is usually not irritating or painful and can many times go unnoticed without the presence of any systemic involvement, presenting as flu like symptoms (Pearson, 2015).

Early dissemination of Lyme disease accompanies symptoms of fever, headache, musculoskeletal pain, and general malaise. Secondary lesions of erythema migrans may also be present (Pearson, 2015). Many other body systems begin to be affected as *Borrelia burgdorferi* migrates throughout the tissues.



Centers for Disease Control and Prevention, <http://phil.cdc.gov/phil/>

Joint and muscles are commonly affected causing pain with or without inflammation of the joint. Neurological symptoms present with Bell's palsy like paralysis of the cranial nerves and radicular neuropathies leading to other peripheral manifestations. Cardiovascular symptoms are not as common but can lead to varying degrees of heart block (Bratton et al., 2008).

Late dissemination of Lyme disease involves chronic relapsing and remitting symptoms of the bodily system affected by the bacteria. Peripheral, central and autonomic nervous systems can be chronically affected in some of the population with Lyme disease (Pearson, 2015). This includes a vast and complex presentation of symptoms making diagnosis even more difficult once it has reached the later stages. Pearson (2015) describes these symptoms as encephalopathy, headache, mood changes, peripheral neuropathy, and even blood pressure changes (p. 89). Collagen rich tissues are usually the site of chronic disease including the eyes, nerve tissues and joints causing many sensory and motor deficits (Pearson, 2015).

Left: Erythema Migrans rash after a tick bite.
Copyright 2015 by CDC.

Underlying pathophysiology

The underlying pathophysiology of Lyme disease begins in the white footed mouse acting as the reservoir for *B. burgdorferi* and the deer tick acting as the vector to spread the bacteria to humans. The tick usually feeds for one to two days, transmitting the bacteria through its saliva (Bratton et al., 2008). The initial infection identified as erythema migrans is a localized immune response that takes place in the skin. *B. burgdorferi* disseminates to other organs of the body in about two weeks. The outer surface protein of the bacteria quickly triggers chemokines that attract B cells which then produce antibodies specific to the *B. burgdorferi*. (Halperin, 2014). The inflammatory symptoms are a humoral and cellular immune response to the outer surface protein which is then believed to trigger an auto immune response (Steere, Drouin, & Glickstein, 2015).

The exact microbiology of the disease is still controversial due to the fact that it is very hard to find evidence of bacterial presence in samples thought to be infected with the spirochete. It is hard to imagine that such a small presence of the pathogen is able to create such a strong immune reaction (Halperin, 2015). Chronic joint inflammation along with neurological deficits can persist even when no bacteria is detected after treatment with antibiotics (Steere et al, 2011).

One thing that is certain is that *B burgdorferi* has become proficient at evading immunity through antigenetic variations of the outer surface protein and having the ability to bind to human tissues (Kenedy et al., 2012). This may describe how the human immune system becomes sensitive to self tissues through molecular mimicry eventually attacking its own cells. Once systemic Lyme disease has developed, antibiotics become less effective and chronic relapsing symptoms last throughout the lifetime.

Right: Deer tick commonly found in North America. Copyright 2013 by My Times



Significance of Pathophysiology

The severity of the disease is based entirely on how quickly Lyme disease is recognized and treated along with where the bacteria have colonized in the body. Not everyone presents with the same symptoms since the *B. burgdorferi* bacteria has the ability to invade such a variety of tissues and organs throughout the body. The symptoms tend to vary even more as the disease progresses. For example, one patient may present with complaints of peripheral neuropathy and joint pain while another may only complain of muscle pain. It would appear as if the two cases are completely unrelated when in fact they are both infected with the same pathogen. The only symptom that remains consistent between cases is the early sign of the erythema migrans rash (Pearson, 2015).

The difficulty to diagnose this disease has led to the estimate that as many as one million people are infected each year. This is much higher than the CDC's report of around 30,000 cases annually. The cause of the under diagnosing is the vague and subjective symptoms that present late in the disease along with the strict diagnostic guidelines to make it definitive for Lyme disease (Stricker & Johnson, 2014). Another source claims similar predictions of the true number of new cases, ranking it seventh in infectious diseases in the United States. The same study also reported the financial burden and healthcare resources needed to manage the chronic condition. Research showed that healthcare costs for those with Lyme disease is almost \$3,000 more a year with 87% more outpatient visits compared to the control group (Adrian, Aucott, & Weiner, 2014). This is a clear indication of the debilitating effects of Lyme disease when it has progressed to the later stages

Implications for Nursing Care

The most important aspect of care is early treatment of the disease, but first the diagnosis must be made. Diagnosis can be made one of two ways, usually in a two step combination of the tests. These tests are the enzyme-linked immunosorbent assay, commonly called ELISA, and the Western blot test. The presentation of erythema migrans rash along with patient history of outdoors and exposure to ticks should indicate the presence of infection. Treatment should begin even before the lab results confirm diagnosis (Kowalski, Tata, Berth, Mathiason, & Agger, 2010). As stated earlier, it is difficult to make a diagnosis in the later stages of disease since the healthcare provider only has subjective symptoms that mimic other diseases. This is why it is important to conduct a thorough history including knowledge of geographical hotspots for prevalence of Lyme disease.

The early stage of Lyme disease is easily treated and with a good prognosis. This is when first symptoms of fever and erythema migrans rash are present. The two common antibiotics used to fight the infection is a ten to twenty day treatment of doxycycline or amoxicillin. Research has shown that the exact duration even with treatment less than ten days has no effect on outcome (Kowalski et al, 2010). Late stages of infection are more often difficult to cure. There is no standard treatment for disseminated Lyme disease. Both IV and oral antibiotics are used with controversy that usually point to the ineffective results. Symptoms can be managed with anti-inflammatories, and other treatments based on which bodily system is involved. Unfortunately, there is still much unknown about the actions of the *B. burgdorferi* in the late stages, so there is no set standard of care in the chronic form (Halperin, 2014).

Another important topic to discuss is prevention measures and to educate the patient on signs and symptoms of the disease. This is especially important in areas such as the New England States where the disease is most prevalent. However, it is not limited to those states and can be found anywhere the deer tick can survive. People who are outdoor enthusiasts such as hikers and hunters are at greater risk for Lyme disease and need to be reminded to check their skin for ticks. Insect repellant and protective clothing can offer an effective barrier against ticks getting to the skin. Finally, providing education on common signs and symptoms of disease such as fever and erythema migrans is important so these conditions are not overlooked (Harvard Medical School, 2014).

Conclusion

Lyme disease is a mysterious illness that continues to outsmart those in the medical profession due to its ability to evade human immunity. There is much more research and clinical trials needed to effectively combat or even manage the symptoms of disease once it reaches the chronic form. Lyme disease often goes undetected in the early stages and therefore gets under diagnosed. It can be difficult to diagnose when the symptoms mimic other diseases and affect many different organs of the body. That is why it is so important that healthcare providers are up to date with their knowledge so a diagnosis can be made with immediate treatment. If left untreated, the physical, financial, and emotional toll can last a lifetime.

References

- Adrian, E. R., Aucott, J., Lemke, K. W., & Weiner, J. P. (2015). Health care costs, utilization and patterns of care following Lyme disease. *Plos ONE*, 10(2), 1-14. doi:10.1371/journal.pone.0116767
- Bratton, R. L., Whiteside, J. W., Hovan, M. J., Engle, R. L., & Edwards, F. D. (2008). Diagnosis and treatment of Lyme disease. *Mayo Clinic Proceedings*, 83(5), 566-571. doi:10.4065/83.5.566
- Centers for Disease Control and Prevention. (2015). *How many people get lyme disease?* Retrieved from <http://www.cdc.gov/lyme/stats/humancases.html>
- Halperin, J. J. (2014). Lyme disease: neurology, neurobiology, and behavior. *Clinical Infectious Diseases*, 58(9), 1267-1272
- Harvard Medical School. (2014). Taking Lyme disease to heart: Enjoy the great outdoors, but be on the lookout for disease-carrying pests. *Harvard Heart Letter: From Harvard Medical School*, 24(9), 7. Retrieved from <http://www.health.harvard.edu/heart-health/taking-lyme-disease-to-heart>
- Kenedy, M. R., Lenhart, T. R., & Akins, D. R. (2012). The role of *Borrelia burgdorferi* outer surface proteins. *FEMS Immunology & Medical Microbiology*, 66(1), 1-19. doi:10.1111/j.1574-695X.2012.00980.x
- Kowalski, T. J., Tata, S., Berth, W., Mathiason, M. A., & Agger, W. A. (2010). Antibiotic treatment duration and long-term outcomes of patients with early Lyme disease from a Lyme disease-hyperendemic area. *Clinical Infectious Diseases*, 50(4), 512-520. doi:10.1086/649920
- Pearson, S. (2015). Lyme disease: Cause, symptoms, prevention and treatment. *Nurse Prescribing*, 13(2), 88-93.
- Steere, A. C., Drouin, E. E., & Glickstein, L. J. (2011). Relationship between immunity to *borrelia burgdorferi* outer-surface protein A (OspA) and Lyme arthritis. *Clinical Infectious Diseases: An Official Publication Of The Infectious Diseases Society Of America*, 52(3), 259-265. doi:10.1093/cid/ciq117
- Stricker, R. B., & Johnson, L. (2014). Lyme disease: call for a "Manhattan project" to combat the epidemic. *Plos Pathogens*, 10(1), 1-3. doi:10.1371/journal.ppat.1003796



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