Protecting Yourself from Lyme Disease

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The U.S. Centers for Disease Control (CDC) have reported that tick-borne infections are an increasing public health concern and occur in every state[1]. Lyme disease, transmitted by the deer tick (*Ixodes* spp.), is the fastest growing tick-borne disease in the U.S. causing greater than *300,000 new cases yearly*[1,2]. The cost to the US health care system is estimated at $712 million to $1.3 billion/year[3,4].

Background

The Mid-Atlantic region of the U.S. is highly endemic to Lyme disease[5]. If an orchard and adjacent acreage have a resident deer population, mice, chipmunks, shrews, or ground dwelling birds, very likely they also have deer ticks present. Workers and the pick-your-own public are at risk of being bitten and infected.

Outdoor activities in shady environments that include ground cover, moist humus, leaf litter, tall grass, and deer trails, are ideal tick habitats. As outdoor activities increase each spring, so does the risk of tick bites with ticks becoming active at ≤40°F. May through August are the highest months for risk of infection; however, infections can occur during

any month.

While Lyme disease caused by *Borrelia* spp. is the most reported infection, less well-known tick-borne infections including *Ehrlichia*, *Anaplasma*, *Bartonella*, *Mycoplasma*, *Babesia*, and Southern tick-associated rash illness (STARI) are transmitted by deer ticks and cause serious infections. Deer ticks can transmit several of these infections in the same bite.

Lyme Disease Symptoms

Infection symptoms may include a bull's eye or non-bull's eye rash; intractable fatigue; headache; stiff neck; balance, cognition, memory, and sleep disturbances; light or sound hyper sensitivities; facial paralysis; and possibly panic, anxiety, irritability, aggression, or depression. A rash occurs in ≤ 50% of cases[6]. There is medical debate whether the acute infection phase can continue to a persistent phase; however, there is agreement that 10-20% of treated patients continue to experience years of significant disabling symptoms[1,7] The sensitivity and reliability of Lyme serological testing are also under debate, but Lyme researchers agree that testing shortly after infection will yield a negative result and should not be used as the basis for diagnosis[8]. Because of this, some physicians will base their diagnosis on clinical symptoms.

Outdoor behavior

There are a number of behaviors that can reduce risk of infection:

- Use a piece of impervious ground cover, e.g. plastic or Gore-Tex® when sitting on the ground, stonewalls, woodpiles, or fallen logs as these are likely to be tick infested.
- Walk in the center of well-maintained trails, avoid brushing against vegetation, avoid walking on deer trails, in leaf litter, and in tall grass.
- Check yourself for ticks periodically while in tick-infested areas especially in hair, at the hairline, and where clothes fit tightly. Also, check accompanying dogs for ticks as cases of canine Lyme disease are highly correlated to human cases[9].
- Do not sleep with pets even if they have been treated with a tick control product as surviving ticks can migrate from your pet's fur.
- Increase the chance of seeing ticks by wearing light-colored long pants, a long-sleeved shirt, and closely knitted socks. Shirts should be tucked into pants and pants into socks as these steps will prevent a tick from crawling under the clothing. Wear a hat and bandana.
- Keep outdoor clothing in a sealed plastic bag to be sure that ticks cannot migrate from clothing into living or office spaces.
- During hot weather it is inevitable, but not recommended, that shorts and short-sleeved shirts will be worn while working outdoors. It is essential that all exposed skin be treated with an effective tick repellent.

To check if an orchard is tick infested, flag or drag suspected areas. Flagging involves sweeping a cloth material (i.e., flannel, cotton) attached like a flag to a hand-held pole or dowel and swept through leaf litter or low vegetation. Dragging involves pulling the equivalent cloth material attached to a pole behind the investigator, typically by rope attached to the pole. The cloth is then inspected for ticks. One area of elevated risk for encountering ticks is the shady border where a field or an open clearing meets wooded areas containing deer populations.

Ideally, outdoor equipment should be stored indoors or in sunny areas where ticks are less likely to survive. Orchard leaf litter should be raked, tall grasses mowed, brush around work areas cleared, and trees trimmed to open up wooded areas to allow sunlight to penetrate and reduce the ground level moisture that ticks need to survive.

The ground and low vegetation of the field and woods border can be sprayed in the spring and fall with an acaricide (product to kill ticks) such as permethrin, bifenthrin, deltamethrin, cyfluthrin, cypermethrin, cyhalothrin, or carbaryl (Sevin®). Acaricide applications can be made by professional pest control experts or orchard maintenance personnel. Ready-to-spray products that attach to a hose for application to small areas can be purchased at home and garden centers. Acaricides should not be applied to ground or vegetation near streams, open water, wetlands, wellheads, or orchard trees.

Permethrin Treatment for Outdoor Clothing

Wearing permethrin-treated outdoor clothing is one way to reduce the risk of tick bites.

Permethrin is highly effective for killing ticks and is available in aerosol or spray under several brand names including Sawyer®, Duranon®, Permanone®, and Ultrathon® Clothing and Gear Spray. These products are found in outdoor retail stores in the camping section or online.

In treating outdoor clothing, spray shoes, boots, socks, pants, shorts, shirts, hats, and bandanas. Hang items to be treated on an outdoor clothesline, spray until *wet* and let dry on the line. A soak-treatment product is available that entails placing outdoor clothing in a plastic bag that contains the permethrin solution for several hours and then allowing it to dry on a clothesline before use[10]. Permethrin treatments last 6 weeks, and, according to the label, remain effective through several washings. Label directions should be followed carefully. Permethrin should not be applied to the skin nor sprayed indoors or in enclosed areas. Again, permethrin solutions should not be allowed to enter streams.

U.S. Department of Defense (DoD) developed Insect Shield® outdoor clothing for its standard military field clothing. It is permethrin-pretreated, effective through 70 washings, and has proven successful in DoD testing to prevent tick bites. Insect Shield® clothing is available from ExOfficio, L.L. Bean, Orvis, REI, or other suppliers online. There are several tick-bite prevention types of clothing for sale but only Insect Shield® technology has been proven effective. While expensive, Insect Shield® is an excellent alternative for individuals who do not wish to treat their clothing or want to have protective clothing readily available. Clothes can be sent to Insect Shield® to be treated[11]. Although highly toxic to ticks, permethrin is one of the least toxic mammalian

insecticides and safe once sprays have dried on clothing. A U.S. Army document discusses the use and safety of permethrin[12].

Skin Protection (Repellents)

Next to avoiding tick habitats, using tick repellents along with permethrin-treated clothing is the best way to reduce the risk of tick bites. Tick repellents containing DEET are widely available under many brands including OFF®, Deep Woods OFF®, Cutter© Backwoods, etc. and can be used on skin or clothing. Higher concentrations provide longer protection. Ultrathon™, a DEET repellent developed by the DoD, is a sustained-release DEET formulation available as a lotion, aerosol, and pump spray and can provide up to 12 hours of protection, longer than other DEET products. Repellents containing DEET should not be used on children under 2 months of age[13]. An effective non-DEET repellent is picaridin, contained in Natrapel™ and Sawyer™ Picaridin Insect Repellent. These 20% picaridin products provide 8 hours of protection. *Caution*: Some essential oils are advertised as tick repellents, but there is little to no research data supporting their effectiveness. The American Academy of Pediatrics has information on children and repellents[13].

Tick host treatment

Deer are the preferred host for deer tick reproduction, and mice are the main reservoir for tick-borne infections. Three effective host-targeted approaches to tick control are the four-poster deer treatment station[14], Damminix® tick tubes[15], and the Select TCS™

Control System[16] bait station for mice. These products are an additive approach to targeted barrier sprays.

Tick removal

Attached ticks should be removed promptly as the longer the attachment the greater the risk of infection. Fine pointed tweezers or a tick removal tool are best to remove a tick by grasping the tick as close to the skin as possible and pulling upward slowly until the tick is removed. The bite area should then be disinfected. Prophylactic antibiotic treatment should be considered as it is difficult to determine the length of time from attachment to detection--*if the tick is detected*. The immature deer tick that causes 98% of Lyme infections is only the *size of a poppy seed* (or of a period on this page). A literature review determined that in animal models, transmission can occur in <16 hours, but the minimum attachment time for transmission of infection has never been established[17]. The removed tick should be saved as many physicians will not prescribe antibiotics without seeing the tick. Alcohol, Vaseline®, soap, or a match should never be applied to the attached tick as this may cause release of salivary fluids containing the infectious microbs.

Conclusion

The most effective preventive approach is to avoid tick habitats. However, this is not always possible in the commercial orchard. When working in potentially tick-infested areas, it is advisable to wear permethrin-treated clothing and protect exposed skin with an effective repellent. By learning and following the information in this article, orchard-

workers and their guests can significantly reduce the risk of tick bites and subsequent Lyme or other tick-borne infections. All chemicals work because they have some form of toxicity to either repel or kill ticks so care should always be used, keeping the risk-benefit assessment in mind.

References

1. Centers for Disease Control and Prevention. 2015. Lyme disease frequently asked questions. http://www.cdc.gov/lyme/faq/index. html. Accessed Jan 24, 2017.

2. Hinckley, A. F., Connally, N. P., Meek, J. I., et al. 2014. Lyme disease testing by large commercial laboratories in the United States. Clin Infect Dis. 59(5): 676-681.

3. Johns Hopkins Bloomberg School of Public Health. 2015. Lyme Disease Costs Up to $1.3 Billion Per Year to Treat, Study Finds. http://www.jhsph.edu/news/news-releases/2015/lyme-disease-costs-more-than-one-billion-dollars-per-year-to-treat-study-finds.html. Accessed Jan 24, 2017.

4. Adrion, E. R., Aucott, J., Lemke, K. W. and Weiner, J. P. 2015. Health Care Costs, Utilization and Patterns of Care following Lyme Disease. PLOS ONE DOI: 10.1371/journal.pone.0116767. Accessed Jan 24, 2017.

5. Centers for Disease Control and Prevention. 2015. Lyme disease cases by state. https://www.cdc.gov/lyme/stats/. Accessed Jan 24, 2017.

6. Tibbles, C. D., Edlow, J. A. 2007. Does this patient have erythema migrans? JAMA. 297(23): 2617-2627.

7. Maloney, E. L. 2016. Controversies in Persistent (Chronic) Lyme Disease. Journal of Infusion Nursing. 39(6): 369–375.

8. Cook, M. J. and Puri, B. K. 2016. Commercial test kits for detection of Lyme borreliosis: a meta-analysis of test accuracy. International Journal of General Medicine. 9: 427–440.

9. Duncan, A. W., Correa, M. T., Levine, J. F., Breitschwerdt, E. B. 2004. The dog as a sentinel for human infection: prevalence of *Borrelia burgdorferi* C6 antibodies in dogs from southeastern and mid-Atlantic states. Vector Borne Zoonotic Dis. 4(3): 221-9.

10. Permethrin clothing soak method. www.amazon.ca/Duration-Permethrin-10-Concentrate/dp/B001MA7KPU. Accessed Jan 24, 2017.

11. Insect Shield® your outdoor clothing. www.tickencounter.org/resources/InsectShieldYourOwnClothes_TERC.pdf. Accessed Jan 24, 2017.

12. U.S. Army and permethrin safety.

https://phc.amedd.army.mil/PHC%20Resource%20Library/PermethrinFactory-TreatedArmyCombatUniformsFAQs_FS_18-078-1115.pdf. Accessed Jan 24, 2017.

13. The American Academy of Pediatrics information on children and repellents. www.healthychildren.org/English/safety-prevention/at-play/Pages/Insect-Repellents.aspx. Accessed Jan 24, 2017.

14. Four-poster deer treatment station. C. R. Daniels, Inc., 410-461-2100. Accessed Jan 24, 2017.

15. Damminix® tick tubes. www.ticktubes.com. Accessed Jan 24, 2017.

16. Select TCS™ Control System. www.tickboxtcs.com. Accessed Jan 24, 2017.

17. Cook, M. J. 2015. Lyme borreliosis: a review of data on transmission time after tick attachment. International Journal of General Medicine. 8: 1–8.

Additional information

lymepa.org/

http://www.tickencounter.org/

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