Vector-Borne Diseases in Pets: The Stealth Health Threat

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In 1975, in the small coastal town of Lyme, Connecticut, a group of mothers brought a unique, remarkable clustering of cases to the attention of local health authorities: all had children with diagnosed rheumatoid arthritis. Unfortunately, this malady was not immediately recognized as a bacterial vector-borne disease (VBD). Not until 1985 was “Lyme arthritis” associated with infection by the spirochete Borrelia burgdorferi, by Dr. Willy Burgdorfer.

Throughout the 1980s, many skeptics denounced the existence of Lyme disease, as it came to be known, as a discrete infectious disease of humans or animals. The matter was not settled until the 1990s, when the genome of the causative agent was sequenced and the pathogenesis of the human disease was fully understood.

In fact, the first recorded case of Lyme disease had been described more than a century earlier by Dr. Alfred Buchwald, who noted a degenerative human skin condition known as acrodermatitis chronica atrophicans (ACA). In 1921, Dr. Arvid Afzelius published research about the expanding ring skin lesion (erythema migrans) that is now well associated with Lyme disease in people. Dr. Afzelius speculated that this skin condition was somehow caused by the bite of the deer tick (Ixodes scapularis) and was associated with neurologic symptoms in some patients. Today, human Lyme borreliosis is the most commonly diagnosed infectious VBD, with more than 20,000 cases reported each year in the United States alone.1

The history of the recognition of the insidious and often debilitating signs of Lyme disease illustrates how easily infectious agents can enter the human population and, unsuspected and undetected, wreak medical havoc for decades or longer. The prevalence of clinical and subclinical Lyme borreliosis in pets is poorly understood at present, much as the prevalence of its human counterpart was decades ago. This issue is complicated by a lack of agreement about how to detect infection with the causative agent and controversy about when and whether to immunize pets in endemic areas against B. burgdorferi.2–4

Recent studies suggest that the US prevalence of B. burgdorferi infection in dogs may be highest (more than 6%) in the upper Midwest and northeastern areas of the country, where prevalence of the infection in humans is also highest.5 Studies of this infection in cats are sparse; however, it is clear that cats, while not clinically affected, do become infected.6 What is most clear is that scientific understanding of the importance of this VBD is incomplete and awaits a great deal more research. As this research unfolds, we may

Contributed by the Companion Animal Parasite Council

The Companion Animal Parasite Council (CAPC) is an independent association of veterinarians and other animal health care professionals established to create guidelines for the optimal control of internal and external parasites that threaten the health of pets and people. It brings together broad expertise in parasitology, internal medicine, public health, veterinary law, private practice, and association leadership. Initially convened in 2002, the CAPC was formed with the expressed purpose of changing the way veterinary professionals and pet owners approach parasite management. The CAPC advocates best practices for protecting pets from parasitic infections and reducing the risk for zoonotic parasite transmission. For more information, visit www.capcvet.org.
discover that we have seriously underestimated the importance, prevalence, and severity of borreliosis in companion animals.

Unfortunately, *B. burgdorferi* is only one of a myriad of VBD agents known to infect and cause mild to severe clinical signs in pets. Most of these agents, including *Ehrlichia*, *Anaplasma*, *Rickettsia*, *Bartonella*, *Mycoplasma*, *Babesia*, and *Cytauxzoon* spp, are incompletely characterized. In 2008, Dr. Susan Little, of the University of Oklahoma, speaking at the North American Veterinary Conference, discussed the disturbing findings that tick populations are expanding geographically and appear to be carrying an increasing array of pathogenic organisms. Her data showed that at least one VBD agent exists in each of the 50 US states and that several disease agents are present in the tick populations of many states.

All of these pathogens have at least one thing in common: they are transmitted to companion animals by arthropod vectors worldwide. Only for Lyme disease does a preventive vaccine exist, and the widespread use of this vaccine is controversial among veterinary experts. However, there is hope for control of these vectors and the diseases they transmit to household pets. Regular, appropriate use of arthropod-effective ectoparasiticides in the home environment and, more importantly, on pets, is the most effective preventive measure available against VBD transmission in companion animals. Although these products cannot guarantee prevention of tick-transmitted diseases, regular and correct application can reduce the likelihood that pets will become infected.

**The Vectors and Their Diseases**

Fleas, ticks, and mosquitoes are major arthropod carriers of many potentially serious diseases of humans and pets in the United States. The cat flea, *Ctenocephalides felis*, is the most important flea species infesting dogs and cats in most areas of the world. In addition to causing serious skin irritation, flea bites can lead to the important clinical condition flea allergy dermatitis, caused by injection of flea-specific antigens. Occasionally, severe, even life-threatening, anemia can occur in young or debilitated pets with severe flea infestations.

Infectious agents transmitted by cat fleas include *Bartonella henselae* (the cause of cat-scratch disease in humans), *Rickettsia typhii* (murine or endemic typhus), and *Rickettsia felis* (murine typhus–like disease). Fleas are also the intermediate hosts for a clinically important tapeworm of dogs and cats (*Dipylidium caninum*).

Several tick species are responsible for transmitting diseases of companion animals in North America. Some of the most important are:

- *I. scapularis* and *Ixodes pacificus* (black-legged ticks), vector for *B. burgdorferi* in the eastern and western United States, respectively, as well as for *Anaplasma* and *Bartonella* spp.
- *Rhipicephalus sanguineus* (the brown dog tick, which lives in homes and kennels), vector for *Babesia* spp, *Ehrlichia canis*, and the Rocky Mountain spotted fever pathogen, *Rickettsia rickettsii*.
- *Dermacentor andersonii*, vector for *R. rickettsii* and the tularemia pathogen, *Francisella tularensis*.
- *Dermacentor variabilis*, vector for *Cytauxzoon felis*, *R. rickettsii*, and *F. tularensis*.
- *Amblyomma americanum*, vector for *Ehrlichia* spp, *C. felis*, and *F. tularensis*.
- *Amblyomma maculatum*, vector for *Hepatozoon americanum*.

Mosquitoes are also important disease vectors for pets, notably as carriers of infective heartworm (*Dirofilaria immitis*) larvae. The mosquito species most commonly implicated in heartworm transmission to dogs and cats in the United States are *Aedes* (including the Asian tiger mosquito), *Culex*, *Anopheles*, and *Ochlerotatus* Mosquitoes also carry West Nile virus, which can infect humans and many species of animals, but the importance of this disease in cats and dogs is thought to be small.

**Can We Afford to Ignore Vector-Borne Diseases Any Longer?**

Public health authorities warn that VBDs are spreading from narrow historical ranges well into new areas of the United States. The vectors appear to be moving into new areas and increasing in other areas due to the following factors:

- Natural climate fluctuations that favor the development of fleas, ticks, and mosquitoes
- Mobility of people and pets and residential and recreational encroachment on highly populated wildlife areas
- Population increases among critical reservoir wildlife species, especially deer and wild turkeys, across the country

Adding to the complexity of VBD expansion is the underdiagnosis of VBDs in pets and humans in regions where these diseases are already well established. The years ahead will almost certainly show physicians and veterinarians that VBDs are far more important causes of serious infectious disease in the United States than previously suspected. Improved understanding of the importance of VBDs in humans may well come, in large part, from efforts to better understand and diagnose these diseases in pets.

Although veterinarians play an important role in the identification and prevention of zoonotic infections that affect humans, the profession’s central focus is the success-
ful diagnosis, treatment, and elimination of animal diseases when possible. When it comes to the many important VBDs that affect companion animals, however, veterinarians need to take a step back and also consider measures to prevent transmission of the infectious agent. For example, efforts directed at managing heartworm disease depend on prevention of disease development in animals that have been bitten by an infected mosquito. Although this is a critical aspect of preventing heartworm disease, effective mosquito control should also play a role.

Other important VBDs in dogs and cats remain almost entirely unaddressed. While vaccines exist for preventing Lyme disease in dogs, their use is mired in debate. Lyme disease and other potentially serious infections are not always included in the differential diagnosis of pets that present with fever, lethargy, hematopoietic disturbances (anemia, thrombocytopenia, generalized granulocytopenia), lameness, neurologic disease, kidney failure, and shock, even in areas endemic for VBDs known to cause these signs.

The cost of treating an animal with a VBD, regardless of whether the condition is correctly diagnosed at presentation, can be substantial. Although many infected pets do not succumb to clinical illness, we do not have a clear understanding of which factors influence the development of overt clinical pathology or what percentage of the population of infected companion animals eventually requires treatment. What we do know is that some infected pets present to their veterinarians with mild, moderate, or severe debilitation and that extreme cases require expensive, even heroic, medical care to save their lives. Sadly, delayed treatment or complicating organ failure can lead to lifelong disability or death.

Today, the financial cost of treatment for clinically apparent VBDs can reach thousands of dollars. With early diagnosis, most of these diseases can be treated effectively with antibiotics and simple supportive care at home. Disease that progresses to advanced, multisystemic pathology may require extended hospitalization with intensive care, including repeated laboratory evaluation, constant nursing care, and expensive pharmacologic support. A seriously ill pet may remain debilitated for weeks, exhausting the budget and emotional resources of its family. Worse, the most seriously ill pets do not survive, exacting an enormous emotional toll on not only the family but also the attending veterinarian and staff members.

“An Ounce of Prevention Is Worth a Pound of Cure”

The situation is far from hopeless, despite our primitive understanding of VBDs in veterinary medicine. Although widespread availability and use of effective vaccines against common arthropod-borne diseases are years away, we already have the means to reduce the gathering momentum of these infections in pets. Just as bed netting treated with insecticide (permethrin) is considered an effective means of controlling malaria, a widespread and deadly VBD, in Africa,17–20 available insecticides and repellents are important weapons against VBDs in pets around the world.

Compare the sometimes extraordinary cost of treating clinically apparent VBDs in pets with the relatively low cost of preventive insecticide administration. The modest expenditure required for a year-round, veterinary-recommended, topical ectoparasiticide can help reduce the potential transmission of VBDs to treated pets.21,22 Use of such a product also decreases the environmental parasite load capable of spreading zoonotic disease to other family members.

Unfortunately, many veterinarians recommend environmental and topical insecticide treatment only when their clients mention seeing arthropods on their pets during warmer months. Except for flea allergy dermatitis and heartworm disease, the profession has a low sense of alarm about vector-mediated medical conditions. As a result, the urgency to prevent, rather than treat, the infestation of pets with fleas, ticks, and mosquitoes is low for most practitioners.

The growing threat to the health of companion animals posed by these vectors and the potentially considerable costs of treating VBDs make it essential for veterinarians to use all available means to prevent fleas, ticks, and mosquitoes from transmitting infectious agents to pets and causing disease. The tools to make a significant difference in the epidemiology of VBDs are readily available, and ongoing research is providing the veterinary profession with a pipeline of new products for combating VBDs.

Today’s veterinarians recognize the importance of routine preventive measures in the prevention of infections like canine distemper, canine and feline parvovirus, upper respiratory diseases, and rabies. However, except for Lyme disease, no vaccines exist for the prevention of VBDs. Clinicians must, therefore, understand the crucial role of routine and continuous ectoparasiticide administration in preventing these relatively new and dangerous infectious diseases. Only lack of knowledge about the importance and prevalence of VBDs in companion animals prevents the veterinary profession from arming itself and its patients against the emerging threat of an alarming array of arthropod-transmitted infectious disease agents.

For their part, pet owners need to follow their veterinarians’ directions by using recommended products. Clinicians understand the geography of their region as well as the spectrum of parasites targeted by available products and can make informed, educated recommendations on the proper product for each pet based on the pet’s size and risk factors.

References
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