Ticks: Effects of Their Expanding Range

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Ticks are important parasites of humans, dogs, livestock, and, to a lesser extent, cats. Ticks are one of the most important vectors of severe disease throughout the world. Like many other biologic phenomena, tick distribution and the diseases ticks transmit change with changing climate patterns.

Q: How do ticks transmit diseases?
A: After piercing the host’s skin with biting mouthparts, ticks secrete approximately 120 inflammatory and vasoactive chemicals that ensure an influx of inflammatory cells, prevent clotting, and create favorable conditions to ensure successful blood feeding. Most tick-borne pathogens of mammals are transmitted by hard ticks, although a couple of soft tick species are also of medical interest. Besides the direct transmission of pathogens, tick bites cause local irritation and may predispose a host to secondary bacterial infection. Additionally, some ticks induce an ascending flaccid paralysis in dogs and children; this is caused by a protein toxin elaborated by various species after a few days of feeding.

Q: Which tick species are important parasites of dogs and cats?
A: Ticks that commonly bite dogs and cats include *Ixodes scapularis* (east of the Rocky Mountains), *Ixodes pacificus* (on the West Coast), *Dermacentor variabilis*, *Dermacentor andersoni*, *Dermacentor occidentalis*, *Amblyomma americanum*, *Amblyomma maculatum*, and *Rhipicephalus sanguineus*. All life stages (larva, nymph, adult) of *R. sanguineus*, the brown dog tick, feed on dogs, making this tick species “peridomestic”; that is, it can complete its entire development near human environments, especially kennels and shelters. The other ticks require rodents or other wildlife to feed on as juveniles (larvae and nymphs); generally, only nymphs and adults feed on dogs, cats, and humans.

Q: How do climate and temperature affect tick survival in the environment?
A: Tick survival in nature depends on (1) energy resources, (2) environmental factors such as temperature and relative humidity, and (3) host availability. Fully engorged ticks drop from the host and seek a suitable moist, dark, protected microenvironment in which to lay eggs. The brown dog tick lays eggs and molts in moist cracks of cement and other protected sites common in many kennels and shelters.

In nature, the time at which ticks quest for food is affected by temperature and relative humidity. In some regions of the United States, the defining factor in tick survival is seasonal low temperatures; however, in western North America, the most relevant environmental factor affecting survival is summer desiccation.

Q: How are ticks altering their distribution in response to climate change?
A: The effect of a changing climate on tick survival and distribution varies according to the species. *Ixodes* spp ticks are thought to have expanded their range northward into areas previously too cold to maintain their populations. Additionally, tick mortality in the west is often regulated by hot, dry summers and death due to desiccation; areas that become significantly wetter allow a longer tick-feeding season and potentially higher tick densities. The climatic factors that have expanded tick species’ distributions have changed the types of tick species encountered by clinicians. The most likely change is the northward movement...
of species normally encountered in southern latitudes, including aggressive biters such as Amblyomma spp from Central America and the southern United States as well as Hyalomma spp from the Caribbean.10,11

Q: What are the major diseases that ticks transmit to dogs?
A: Ticks that infest dogs and cats can carry pathogens that cause serious or fatal diseases. Important tick-borne diseases of dogs (and, sometimes, cats) include Lyme disease (borreliosis), anaplasmosis, bartonellosis, babesiosis, ehrlichiosis, and Rocky Mountain spotted fever.

Borreliosis (Lyme disease): Ixodes spp—including I. scapularis (formerly Ixodes dammini in some areas) in the eastern United States, I. pacificus in the western United States, Ixodes ricinus in Europe, and Ixodes persulcatus in Asia—are vectors for Lyme disease, granulocytic anaplasmosis, and, it is suspected, bartonellosis.12 Lyme disease is caused by the spirochete Borrelia burgdorferi. After a tick bite, the spirochete is inoculated into the skin and connective tissue and may disseminate to joints and other areas of connective tissue as well as the heart. The spirochete and its effects can remain for months or years. Although Lyme disease is generally subclinical, severe manifestations can include fever, arthritis, and neurologic and cardiac dysfunction. B. burgdorferi infection can cause fatal nephritis and renal failure.13

Anaplasmosis: Granulocytic anaplasmosis is a relatively common disease caused by Anaplasma phagocytophilum, a rickettsial pathogen that targets neutrophils.13 Anaplasmosis is emerging in California, the upper Midwest, and North Atlantic states. The pathogen infects people, horses, dogs, and wildlife. Clinical signs include fever, muscle and joint pain, and, in people, headache. Horses are particularly susceptible to icterus, head pressing, and lower limb edema. However, most infections go unnoticed because they do not cause clinical signs in many species.

Bartonellosis: Bartonella spp are gram-negative bacterial parasites of red blood cells. Bartonella vinsonii subsp berkhoffii, a serious pathogen of dogs, appears to be transmitted by Ixodes spp ticks. B. vinsonii subsp berkhoffii causes endocarditis and granulomatous lymphadenitis in dogs.15

Babesiosis: The brown dog tick transmits Babesia gibsoni, Babesia canis, Ehrlichia canis, and, likely, Anaplasma platys.16 The protozoa B. gibsoni and B. canis cause babesiosis. Most US cases occur in the southeastern states, the Midwest, and Arizona. Dogs present as weak and depressed and may have splenomegaly, hemolytic anemia with bilirubinuria, and thrombocytopenia, eventually resulting in disseminated intravascular coagulopathy or immune-mediated glomerulonephritis. Subclinical infection is common. American pit bull terriers, in particular, may be subclinically affected carriers of B. gibsoni.17 In addition, the prevalence of B. canis in apparently healthy greyhounds is very high (up to 46%).18

Ehrlichiosis: E. canis targets monocytes and is the most common ehrlichial agent found in sick dogs.14 Abnormal findings due to infection include fever, lymphadenopathy, anemia, and thrombocytopenia in the early stage. Canine ehrlichiosis may enter a second subclinical stage for months or years, although the serologic titer may increase. In less than 10% of dogs, ehrlichiosis may enter a third stage of systemic disease involving bone marrow suppression and pancytopenia.19 Affected dogs may have very high titers and vague, generalized signs of systemic disease associated with immune complexes, including lethargy, weight loss, lymphadenomegaly and splenomegaly, uveitis and retinitis, bleeding from the eyes and nose, and blood in the feces. German shepherds are predisposed to more severe disease.

Rocky Mountain spotted fever: Rocky Mountain spotted fever is caused by Rickettsia rickettsii and transmitted by the ticks D. andersoni, D. variabilis, and R. sanguineus. Cases in humans and animals are uncommon west of the Rocky Mountains, while the disease appears to be emerging in
the southeast United States. R. rickettsii invades endothelial cells, leading to vasculitis and causing especially severe lesions on the skin, brain, heart, and kidneys. Skin lesions range from vesicular, hyperemic lesions to severe necrosis. There may be mucosal, genital, and retinal petechiae and hemorrhages. Ultimately, the disease can cause shock or central nervous system disease, both of which can be fatal.

Numerous tick-transmitted diseases can affect dogs and, to a lesser extent, cats. Environmental changes due to human encroachment, climate changes, and other anthropogenic effects will likely modify canine and feline tick-transmitted diseases and, in many cases, increase their incidence.

References