What's Eating You? *Rhipicephalus* Ticks Revisited

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PRACTICE **POINTS**

- *Rhipicephalus* ticks are vectors of a variety of diseases, including the rickettsial diseases Rocky Mountain spotted fever and Mediterranean spotted fever.
- Presenting symptoms of a tick bite include intensely pruritic, erythematous papules and nodules at the site of tick attachment.
- If rickettsial disease is suspected, treatment with doxycycline should be initiated immediately; do not delay treatment to await results of confirmatory tests or because of the absence of a rash.
- Primary methods of prevention of tick-borne disease include repellents, protective clothing, vector control, and prompt removal of the tick.

Rhipicephalus ticks are vectors of disease in humans and animals. *Rhipicephalus sanguineus* sensu lato (the brown dog tick) is one of the most geographically widespread tick species worldwide, likely due to its ability to colonize human and canine dwellings over a range of habitats. They transmit a variety of diseases to dogs and humans, including canine babesiosis, canine monocytic ehrlichiosis, hepatozoonosis, Mediterranean spotted fever, and Rocky Mountain spotted fever. Tick bites manifest as intensely pruritic, erythematous papules at the site of tick attachment; symptomatic relief usually can be achieved with topical antipruritics. Prevention of tick bites is best achieved through a combination of veterinary and environmental control; protective clothing; repellents, such as N,N-diethyl-meta-toluamide (DEET) and permethrin; and prompt identification and removal of ticks.

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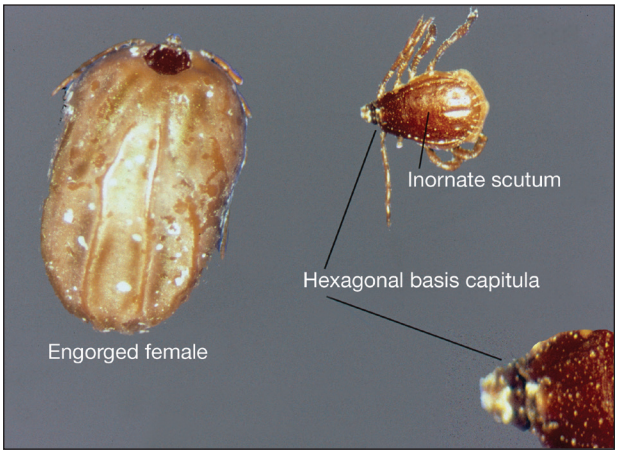
Characteristics

Rhipicephalus ticks belong to the Ixodidae family of hard-bodied ticks. They are large and teardrop shaped with an inornate scutum (hard dorsal plate) and relatively short mouthparts attached at a hexagonal basis capitulum (base of the head to which mouthparts are attached)(Figure).[1] Widely spaced eyes and festoons also are present. The first pair of coxae—attachment base for the first pair of legs—are characteristically bifid; males have a pair of sclerotized adanal plates on the ventral surface adjacent to the anus as well as accessory adanal shields.[2] *Rhipicephalus* (formerly *Boophilus*) *microplus* (the so-called cattle tick) is



Rhipicephalus ticks are brown and teardrop shaped with an inornate scutum. The hexagonal basis capitulum is a defining characteristic. The image is in the public domain.

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a newly added species; it lacks posterior festoons, and the anal groove is absent.[3]

Almost all *Rhipicephalus* ticks, except for *R microplus*, are 3-host ticks in which a single blood meal is consumed from a vertebrate host at each active life stage—larva, nymph, and adult—to complete development.[4,5] In contrast to most ixodid ticks, which are exophilic (living outside of human habitation), the *Rhipicephalus sanguineus* sensu lato species (the brown dog tick) is highly endophilic (adapted to indoor living) and often can be found hidden in cracks and crevices of walls in homes and peridomestic structures.[6] It is predominately monotropic (all developmental stages feed on the same host species) and has a strong host preference for dogs, though it occasionally feeds on other hosts (eg, humans).[7] Although most common in tropical and subtropical climates, they can be found anywhere there are dogs due to their ability to colonize indoor dwellings.[8] In contrast, *R microplus* ticks have a predilection for cattle and livestock rather than humans, posing a notable concern to livestock worldwide. Infestation results in transmission of disease-causing pathogens, such as *Babesia* and *Anaplasma* species, which costs the cattle industry billions of dollars annually.[9]

Clinical Manifestations and Treatment

Tick bites usually manifest as intensely pruritic, erythematous papules at the site of tick attachment due to a local type IV hypersensitivity reaction to antigens in the tick's saliva. This reaction can be long-lasting. In addition to pruritic papules following a bite, an attached tick can be mistaken for a skin neoplasm or nevus. Given that ticks are small, especially during the larval stage, dermoscopy may be helpful in making a diagnosis.[10] Symptomatic relief usually can be achieved with topical antipruritics or oral antihistamines.

Of public health concern, brown dog ticks are important vectors of *Rickettsia rickettsii* (the causative organism of Rocky Mountain spotted fever [RMSF]) in the Western hemisphere, and *Rickettsia conorii* (the causative organism of Mediterranean spotted fever [MSF][also known as Boutonneuse fever]) in the Eastern hemisphere.[11] Bites by ticks carrying rickettsial disease classically manifest with early symptoms of fever, headache, and myalgia, followed by a rash or by a localized eschar or tache noire (a black, necrotic, scabbed lesion) that represents direct endothelial invasion and vascular damage by *Rickettsia*.[12] Rocky Mountain spotted fever and MSF are more prevalent during summer, likely due, in part, to the combination of increased outdoor activity and a higher rate of tick-questing (host-seeking) behavior in warmer climates.[4,7]

Rocky Mountain Spotted Fever—Dermacentor variabilis is the primary vector of RMSF in the southeastern United States; *Dermacentor andersoni* is the major vector of RMSF in Rocky Mountain states. *Rhipicephalus sanguineus* sensu lato is an important vector of RMSF in the southwestern United States, Mexico, and Central America.[11,13]

Early symptoms of RMSF are nonspecific and can include fever, headache, arthralgia, myalgia, and malaise. Gastrointestinal tract symptoms (eg, nausea, vomiting, anorexia) may occur; notable abdominal pain occurs in some patients, particularly children. A characteristic petechial rash occurs in as many as 90% of patients, typically at the third to fifth day of illness, and classically begins on the wrists and ankles, with progression to the palms and soles before spreading centripetally to the arms, legs, and trunk.[14] An eschar at the inoculation site is uncommon in RMSF; when present, it is more suggestive of MSF.[15]

The classic triad of fever, headache, and rash is present in 3% of patients during the first 3 days after a tick bite and in 60% to 70% within 2 weeks.[16] A rash often is absent when patients first seek medical attention and may not develop (absent in 9% to 12% of cases; so-called spotless RMSF). Therefore, absence of rash should not be a reason to withhold treatment.[16] Empiric treatment with doxycycline should be started promptly for all suspected cases of RMSF because of the rapid progression of disease and an increased risk for morbidity and mortality with delayed diagnosis.

Patients do not become antibody positive until 7 to 10 days after symptoms begin; therefore, treatment should not be delayed while awaiting serologic test results. The case fatality rate in the United States is estimated to be 5% to 10% overall and as high as 40% to 50% among patients who are not treated until day 8 or 9 of illness.[17]

Cutaneous complications include skin necrosis and gangrene due to continuous tissue damage in severe cases.[16] Severe infection also may manifest with signs of multiorgan system damage, including altered mental status, cerebral edema, meningismus, transient deafness, myocarditis, pulmonary hemorrhage and edema, conjunctivitis, retinal abnormalities, and acute renal failure.[14,16] Risk factors for more severe illness include delayed treatment, age 40 years or older or younger than 10 years, and underlying medical conditions such as alcoholic liver disease and glucose-6-phosphate dehydrogenase deficiency. However, even some healthy young patients die of this disease.[17]

Mediterranean Spotted Fever—Rhipicephalus sanguineus sensu lato is the primary vector of MSF, which is prevalent in areas adjacent to the Mediterranean Sea, including southern Europe, Africa, and Central Asia; Sicily is the most highly affected region.[18] Findings with MSF are nearly identical to those of RMSF, except that tache noire is more common, present in as many as 70% of cases at the site of the inoculating tick bite, and MSF typically follows a less severe clinical course.[12] Similar to other rickettsial diseases, the pathogenesis of MSF involves direct injury to vascular endothelial cells, causing a vasculitis that is responsible for the clinical abnormalities observed.

Patients with severe MSF experience complications similar to severe RMSF, including neurologic manifestations and multiorgan damage.[18] Risk factors include advanced age, immunocompromised state, cardiac

disease, chronic alcoholism, diabetes mellitus, glucose-6-phosphate dehydrogenase deficiency, respiratory insufficiency, and delayed treatment.[18]

Treatment—For all spotted fever group rickettsial infections, doxycycline is the treatment of choice for all patients, including children and pregnant women. Treatment should be started without delay; recommended dosages are 100 mg twice daily for children weighing more than 45 kg and adults, and 2.2 mg/kg twice daily for children weighing 45 kg or less.[12]

Rhipicephalus tick bites rarely can result in paralysis; however, *Dermacentor* ticks are responsible for most cases of tick-related paralysis in North America. Other pathogens proven or reputed to be transmitted by *Rhipicephalus sanguineus* sensu lato with zoonotic potential include but are not limited to *Rickettsia massiliae*, *Coxiella burnetti*, *Anaplasma platys*, *Leishmania infantum*, and Crimean-Congo hemorrhagic fever virus (Nairovirus).[19]

Environmental Treatment and Prevention

The most effective way to prevent tick-borne illness is avoidance of tick bites. Primary prevention methods include vector control, use of repellents (eg, N,N-diethyl-meta-toluamide [DEET]), picaridin, permethrin), avoidance of areas with a high tick burden, use of protective clothing, and detection and removal of ticks as soon as possible.

Environmental and veterinary controls also are important methods of tick-bite prevention. A veterinarian can recommend a variety of agents for dogs and cats that prevent attachment of ticks. Environmental controls include synthetic or natural product-based chemical acaricides and nonchemical methods, such as landscape management (eg, sealing cracks and crevices in homes and controlling tall grasses, weeds, and leaf debris) to minimize potential tick habitat.[20] Secondary prevention includes antibiotics for prophylaxis or for treatment of tick-borne disease, when indicated.

Numerous tick repellents are available commercially; others are being studied. DEET, the most widely used topical repellent, has a broad spectrum of activity against many tick species.[21] In addition, DEET has a well-known safety and toxicity profile, with rare adverse effects, and is safe for use in pregnant women and children older than 2 years. Alternative repellents, such as those containing picaridin, ethyl butylacetylaminopropionate (IR3535 [Merck]), oil of lemon eucalyptus, and 2-undecanone can be effective; some show efficacy comparable to that of DEET.[22] Permethrin, a synthetic pyrethroid, is a highly efficacious tick repellent and insecticide, especially when used in conjunction with a topical repellent such as DEET. Unlike topically applied repellents, permethrin spray is applied to fabric (eg, clothing, shoes, bed nets, camping gear), not to skin.

Indiscriminate use of acaricides worldwide has led to increasing selection of acaricide resistance in *Rhipicephalus* tick species, which is especially true with the use of acaricides in controlling *R microplus* livestock infestations; several tick populations now show resistance to all major classes of these compounds.[23-25] For that reason, there has been an increasing effort to develop new chemical and nonchemical approaches to tick control that are more environmentally sustainable and strategies to minimize development and progression of resistance such as rotation of acaricides; reducing the frequency of their application; use of pesticide mixtures, synergists, or both; and increasing use of nonacaricidal methods of control.[26]

Prompt removal of ticks is important for preventing the transmission of tick-borne disease. Proper removal involves rubbing the tick in a circular motion with a moist gauze pad or using fine-tipped tweezers to grasp the tick as close to the skin surface as possible and pulling upward with a steady pressure.[17,27] It is important not to jerk, twist, squeeze, smash, or burn the tick, as this can result in insufficient removal of mouthparts or spread contaminated tick fluids to mucous membranes, increasing the risk for infection. Application of petroleum jelly or nail polish to aid in tick removal have not been shown to be effective and are not recommended.[16,28]

REFERENCES

1. Dantas-Torres F. The brown dog tick, *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae): from taxonomy to control. *Vet Parasitol*. 2008;152:173-185. doi:10.1016/j.vetpar.2007.12.030
2. Madder M, Fourie JJ, Schetters TPM. Arachnida, Metastigmata, Ixodidae (except *Ixodes holocyclus*). In: Marchiondo AA, Cruthers LR, Fourie JJ, eds. *Parasiticide Screening: In Vitro and In Vivo Tests With Relevant Parasite Rearing and Host Infection/Infestation Methods*. Volume 1. Elsevier Academic Press; 2019:19-20.
3. Burger TD, Shao R, Barker SC. Phylogenetic analysis of mitochondrial genome sequences indicates that the cattle tick, *Rhipicephalus (Boophilus) microplus*, contains a cryptic species. *Mol Phylogenet Evol*. 2014;76:241-253. doi:10.1016/j.ympev.2014.03.017
4. Gray J, Dantas-Torres F, Estrada-Peña A, et al. Systematics and ecology of the brown dog tick, *Rhipicephalus sanguineus*. *Ticks Tick Borne Dis*. 2013;4:171-180. doi:10.1016/j.ttbdis.2012.12.003
5. Tian Y, Lord CC, Kaufman PE. Brown dog tick, *Rhipicephalus Sanguineus* Latrielle (Arachnida: Acari: Ixodidae): EENY-221 /IN378. *EDIS*. March 26, 2020. Accessed January 3, 2024. https://doi.org/10.32473/edis-in378-2020
6. Saleh MN, Allen KE, Lineberry MW, et al. Ticks infesting dogs and cats in North America: biology, geographic distribution, and pathogen transmission. *Vet Parasitol*. 2021;294:109392. doi:10.1016/j.vetpar.2021.109392
7. Dantas-Torres F. Biology and ecology of the brown dog tick, *Rhipicephalus sanguineus*. *Parasit Vectors*. 2010;3:26. doi:10.1186 /1756-3305-3-26
8. Dryden MW, Payne PA. Biology and control of ticks infesting dogs and cats in North America. *Vet Ther*. 2004;5:139-154.
9. Nyangiwe N, Yawa M, Muchenje V. Driving forces for changes in geographic range of cattle ticks (Acari: Ixodidae) in Africa: a Review. *S Afr J Anim Sci*. 2018;48:829. doi:10.4314/sajas.v48i5.4
10. Ramot Y, Zlotogorski A, Mumcuoglu KY. Brown dog tick (*Rhipicephalus sanguineus*) infestation of the penis detected by dermoscopy. *Int J Dermatol*. 2012;51:1402-1403. doi:10.1111/j.1365-4632.2010.04756.x
11. Tucker NSG, Weeks ENI, Beati L, et al. Prevalence and distribution of pathogen infection and permethrin resistance in tropical and temperate populations of *Rhipicephalus sanguineus* s.l. collected worldwide. *Med Vet Entomol*. 2021;35:147-157. doi:10.1111/mve.12479
12. McClain MT, Sexton DJ, Hall KK, eds. Other spotted fever group rickettsial infections. *UpToDate*. Updated October 10, 2022. Accessed January 3, 2024. https://www.uptodate.com/contents /other-spotted-fever-group-rickettsial-infections

13. Ribeiro CM, Carvalho JLB, Bastos PAS, et al. Prevalence of *Rickettsia rickettsii* in ticks: systematic review and meta-analysis. *Vector Borne Zoonotic Dis*. 2021;21:557-565. doi:10.1089/vbz.2021.0004
14. Pace EJ, O'Reilly M. Tickborne diseases: diagnosis and management. *Am Fam Physician*. 2020;101:530-540.
15. Patterson JW. *Weedon's Skin Pathology*. 5th ed. Elsevier; 2020.
16. Dantas-Torres F. Rocky Mountain spotted fever. *Lancet Infect Dis*. 2007;7:724-732. doi:10.1016/S1473-3099(07)70261-X
17. Biggs HM, Behravesh CB, Bradley KK, et al. Diagnosis and management of tickborne rickettsial diseases: Rocky Mountain spotted fever and other spotted fever group rickettsioses, ehrlichioses, and anaplasmosis—United States. *MMWR Recomm Rep*. 2016;65:1-44. doi:10.15585/mmwr.rr6502a1
18. Rossio R, Conalbi V, Castagna V, et al. Mediterranean spotted fever and hearing impairment: a rare complication. *Int J Infect Dis*. 2015;35:34-36. doi:10.1016/j.ijid.2015.04.005
19. Dantas-Torres F, Otranto D. Further thoughts on the taxonomy and vector role of *Rhipicephalus sanguineus* group ticks. *Vet Parasitol*. 2015;208:9-13. doi:10.1016/j.vetpar.2014.12.014
20. Eisen RJ, Kugeler KJ, Eisen L, et al. Tick-borne zoonoses in the United States: persistent and emerging threats to human health. *ILAR J*. 2017;58:319-335. doi:10.1093/ilar/ilx005
21. Nguyen QD, Vu MN, Hebert AA. Insect repellents: an updated review for the clinician. *J Am Acad Dermatol*. 2018;88:123-130. doi:10.1016/j.jaad.2018.10.053
22. Pages F, Dautel H, Duvallet G, et al. Tick repellents for human use: prevention of tick bites and tick-borne diseases. *Vector Borne Zoonotic Dis*. 2014;14:85-93. doi:10.1089/vbz.2013.1410
23. Rodriguez-Vivas RI, Alonso-Díaz MA, et al. Prevalence and potential risk factors for organophosphate and pyrethroid resistance in *Boophilus microplus* ticks on cattle ranches from the State of Yucatan, Mexico. *Vet Parasitol*. 2006;136:335-342. doi:10.1016/j.vetpar.2005.05.069
24. Rodríguez-Vivas RI, Rodríguez-Arevalo F, Alonso-Díaz MA, et al. Prevalence and potential risk factors for amitraz resistance in *Boophilus microplus* ticks in cattle farms in the State of Yucatan, Mexico. *Prev Vet Med*. 2006;75:280-286. doi:10.1016/j.prevetmed.2006.04.001
25. Perez-Cogollo LC, Rodriguez-Vivas RI, Ramirez-Cruz GT, et al. First report of the cattle tick *Rhipicephalus microplus* resistant to ivermectin in Mexico. *Vet Parasitol*. 2010;168:165-169. doi:10.1016/j.vetpar.2009.10.021
26. Rodriguez-Vivas RI, Jonsson NN, Bhushan C. Strategies for the control of *Rhipicephalus microplus* ticks in a world of conventional acaricide and macrocyclic lactone resistance. *Parasitol Res*.2018; 117:3-29. doi:10.1007/s00436-017-5677-6
27. Centers for Disease Control and Prevention. Tick removal. Updated May 13, 2022. Accessed January 3, 2024. https://www.cdc.gov/ticks/removing_a_tick.html
28. Diaz JH. Chemical and plant-based insect repellents: efficacy, safety, and toxicity. *Wilderness Environ Med*. 2016;27:153-163. doi:10.1016/j.wem.2015.11.007