

Tick-Borne Diseases

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Microbes

Most tick-borne diseases are caused by microbes which fall into four general categories: bacteria, *Rickettsia*, viruses, and protozoa. The *Rickettsia* category is the largest of the four, containing at least 20 different diseases caused by bacteria in the genus *Rickettsia*. The bacteria category includes anaplasmosis, ehrlichiosis, Lyme disease, and tularemia. Diseases caused by viruses include Colorado Tick Fever, Crimean-Congo Hemorrhagic Fever, Powassan, and Tick-borne Encephalitis. Babesiosis is caused by protozoa. A disease known not caused by a microbe is Tick Paralysis, which is caused by a toxin.

Geography

The geographical distribution of these diseases is dependent on the distribution of the ticks that act as the disease vectors. The four diseases in the bacteria category all occur within the U.S., with Lyme disease and tularemia being transmitted internationally as well. Viral diseases within the U.S. are Colorado Tick Fever and Powassan. The other diseases with cases in the U.S. are babesiosis, tick paralysis, and Southern-Tick Associated Rash Illness (STARI). Of the many rickettsial diseases, only Rocky Mountain Spotted Fever (RMSF) and spotted fever caused by *Rickettsia parkeri* and *Rickettsia* species 364D occur in the U.S. The other diseases are seen worldwide, with many affecting only certain regions due to the specific distribution of each particular *Rickettsia* species.

The ticks that act as vectors for these diseases all fall under the family Ixodidae, which are characterized by a protective hard shield. However a tick engorged with blood is easily crushed. The known genera of disease-causing ticks include *Ixodes*, *Dermacentor*, *Amblyomma*, *Hyalomma*, *Rhipicephalus*, and *Haemaphysalis*. The species of ticks that transmit diseases within the U.S. are the American dog tick (*Dermacentor variabilis*), Blacklegged tick (*Ixodes scapularis*), Brown dog tick (*Rhipicephalus sanguineus*), Gulf Coast tick (*Amblyomma maculatum*), Lone star tick (*Amblyomma americanum*), Rocky Mountain wood tick (*Dermacentor andersoni*), and Western blacklegged tick (*Ixodes pacificus*).

Epidemiology

The most commonly reported tick-borne disease in the U.S. and Europe is Lyme Disease, with 22,500 confirmed and 7,500 probable cases reported in the U.S. in 2010 (CDC). The most frequently diagnosed rickettsial disease related to international travel is African tick-bite fever. The most deadly tick-borne diseases are RMSF and Powassan encephalitis. RMSF can be fatal within eight days of symptoms unless treated. Powassan encephalitis is fatal in 10% of cases and has no available treatment.

Clinical Manifestation

The tick-borne diseases manifest similar symptoms, which include fever, headache, rash, myalgia, fatigue, nausea, vomiting, diarrhea, and confusion. In particular, a maculopapular or petechial rash with an eschar may be present in rickettsial diseases. A few diseases have unique symptoms that may suggest the diagnosis. Meningitis and encephalitis can develop in Powassan and Tick-borne encephalitis. Lyme disease has the characteristic symptoms of erythema migrans and Bell's palsy. STARI can manifest a bull's-eye lesion similar to erythema migrans. Tick paralysis will lead to ascending paralysis starting in the feet and legs.

Laboratory Diagnosis

Laboratory confirmation of a diagnosis is usually by PCR, serologic assay, or culture. For Babesiosis and Colorado Tick Fever, examination of blood smears can lead to a diagnosis.

Therapy

Doxycycline is the first line treatment for all of the diseases that fall into the bacteria and *Rickettsia* categories. Babesiosis is treated with a combination of atovaquone plus azithromycin or clindamycin plus quinine. Tick paralysis is treated by the removal of the tick. No specific treatment exists for any of the viral diseases, with the exception of ribavirin for Crimean-Congo Hemorrhagic Fever. It is currently unknown if antibiotics are needed for the treatment of STARI, but many physicians treat it the same way as Lyme disease due to their similarities.

References

1. Center for Disease Control and Prevention (www.cdc.gov)
2. American Lyme Disease Foundation (<http://www.aldf.com>)
3. Healthline (<http://www.healthline.com/health/colorado-tick-fever>)
4. Lyme and Tick-Borne Disease Research Center (<http://www.columbia-lyme.org>)
5. United Kingdom National Health Service (www.nhs.uk)
6. Antimicrobe (www.antimicrobe.org)

Table

Disease	Microbe	Vector	Geographic Distribution
Bacteria			
Anaplasmosis	<i>Anaplasma phagocytophilum</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i>	U.S.
Ehrlichiosis	<i>Ehrlichia chaffeensis</i> <i>Ehrlichia ewingii</i> <i>Ehrlichia muris-like</i>	<i>Amblyomma americanum</i>	U.S.
Lyme Disease	<i>Borrelia burgdorferi</i> <i>Borrelia afzelii</i> <i>Borrelia garinii</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i>	U.S., Europe, northern Asia
Tularemia	<i>Francisella tularensis</i>	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Amblyomma americanum</i> <i>Chrysops spp.</i>	Worldwide
Rickettsia			
Rocky Mountain Spotted Fever, febre maculosa, Sao Paulo exanthematic typhus, Minas Gerais exanthematic typhus, Brazillian spotted fever	<i>Rickettsia rickettsii</i>	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Rhipicephalus sanguineus</i>	Americas
Rickettsia parkeri	<i>Rickettsia parkeri</i>	<i>Amblyomma maculatum</i> (Gulf Coast tick)	Eastern and southern U.S.
Rickettseia species 364D	<i>Rickettseia</i> species 364D	<i>Dermacentor occidentalis</i> (Pacific Coast tick)	Northern California, Pacific Coast
Rickettsiosis	<i>Rickettsia aeschlimannii</i>	<i>Hyalomma marginatum</i>	Africa, Mediterranean
African tick- bite fever	<i>Rickettsia africae</i>	<i>Amblyomma variegatum</i>	Sub-Saharan Africa, West Indies
Queensland tick typhus	<i>Rickettsia australis</i>	<i>Ixodes holocyclus</i>	Australia

Mediterranean spotted fever or Boutonnoise fever	<i>Rickettsia conorii</i>	<i>Rhipicephalus sanguineus</i>	Asia, Africa
Far eastern spotted fever	<i>Rickettsia heilongjiangensis</i>	<i>Haemaphysalis concinna</i>	Northern China, Eastern Asia
Aneruptive fever	<i>Rickettsia helvetica</i>	<i>Ixodes</i> ticks	Central and northern Europe
Flinders Island spotted fever, Thai tick typhus	<i>Rickettsia honei</i>	Unknown	Flinders Island (Australia), Thailand
Japanese spotted fever	<i>Rickettsia japonica</i>	<i>Dermacentor</i> and <i>Haemaphysalis</i> ticks	Japan
Australian spotted fever	<i>Rickettsia marmionii</i> subspecies		Australia
<i>Rickettsia massiliae</i> rickettsioses	<i>Rickettsia massiliae</i>	<i>Rhipicephalus turanicus</i>	Europe, Central Africa, Mali
North Asian tick typhus, Siberian tick typhus	<i>Rickettsia sibirica</i>	<i>Dermacentor</i> ticks	North Asia, Europe, USSR, China
Lymphangitis associated rickettsiosis	<i>Rickettsia sibirica mongolotimonae</i>	<i>Hyalomma asiaticum</i>	Southern France, Portugal, China, Sub-saharan Africa
Tick-borne lymphadenopathy (TIBOLA), <i>Dermacentor</i> -borne necrosis and lymphadenopathy (DEBONEL)	<i>Rickettsia slovaca</i>	<i>Dermacentor marginatus</i>	Southern and eastern Europe, Asia
Israeli spotted fever	Unnamed	<i>Rhipicephalus sanguineus</i>	Israel, Portugal, Sicily
Astrakhan fever	unnamed	<i>Rhipicephalus sanguineus</i> <i>Rhipicephalus pumilio</i>	Astrakhan region (Russia)
Spotted fever	<i>Rickettsia mongolotimonae</i>	<i>Hyalomma</i> ticks	Europe, China

Wood scar	<i>Rickettsia slovaca</i>	<i>Dermacentor marginatus</i>	Europe
Viruses			
Colorado Tick Fever	Colorado tick fever virus (CTFV)	<i>Dermacentor andersoni</i>	Western U.S., western Canada
Crimean-Congo Hemorrhagic Fever	<i>Nairovirus</i> in family <i>Bunyaviridae</i>	Ixodid (hard) ticks	Europe, Asia, Africa, Middle East
Powassan Encephalitis	RNA virus in genus <i>Flavivirus</i>	<i>Ixodes scapularis</i> <i>Ixodes cookei</i> <i>Ixodes marxi</i>	Northeastern U.S., Canada, Russia
Tick-borne Encephalitis	Tick-borne encephalitis virus (TBEV) in family <i>Flaviviridae</i>	<i>Ixodes scapularis</i> <i>Ixodes ricinus</i> <i>Ixodes persulcatus</i>	Europe, Asia
Protozoa			
Babesiosis	<i>Babesia microti</i>	<i>Ixodes scapularis</i>	Worldwide
Toxin			
Tick Paralysis	None	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Amblyomma</i> and <i>Ixodes</i> ticks	Worldwide
Unknown			
Southern Tick-Associated Rash Illness (STARI)	Unknown	<i>Amblyomma americanum</i>	Midwest, Southern, and Eastern U.S.