Medical Summary

OTHER TICK-BORNE DISEASES

This article covers babesiosis, anaplasmosis, and ehrlichiosis.

See *Rickettsial Infections* (tick-borne rickettsia), *Lyme Disease*, and *Tick-Borne Encephalitis* for information on other tick-borne diseases of importance to travelers.

Also see *Lyme Disease*, *Infestations in Travelers*, and *Viral Hemorrhagic Fevers* for diseases that thus far have not been identified as major threats to travelers, including Southern tick-associated rash illness (STARI), tick-borne relapsing fever, tularemia, and Crimean-Congo hemorrhagic fever.

INTRODUCTION

Ticks are ubiquitous arthropods that are vectors of a number of pathogens.

The disease agents of human babesiosis, anaplasmosis, and ehrlichiosis include *Babesia* spp., *Anaplasma phagocytophilum* (formerly *Ehrlichia phagocytophilum*), *Ehrlichia chaffeensis*, and *E. ewingii*. *Babesia* is a protozoan parasite resembling malaria, whereas Anaplasma and Ehrlichia are small obligate intracellular bacteria. All 3 tick-borne infections range from asymptomatic/subclinical to mild febrile illness to severe disease involving multi-organ failure.

Tick-borne infections have geographic distributions that follow the respective arthropod vectors. Babesiosis, anaplasmosis, and ehrlichiosis are usually acquired in rural settings within the endemic areas, although peri-urban/suburban transmission also occurs. Tick-borne infections are most commonly acquired during late spring and summer, when the larvae and nymphs are feeding. Ticks in these stages are small and difficult to detect. Humans are also more active outdoors during these seasons. If a tick feeds on a host that has a bloodborne infection, the tick becomes infected and, during its next feeding, a small amount of tick saliva enters the skin of the next host and transmits the pathogen.

GEOGRAPHIC DISTRIBUTION

Babesiosis

North America

In the U.S., there are 3 regions of high babesiosis activity: the area from Maine to Maryland on the East Coast, Wisconsin and Minnesota in the Midwest, and northern California and Oregon on the West Coast. The center of the country exhibits little or no risk of transmission. In 2011, there were 1,124 cases of babesiosis reported, most from 7 states: Connecticut, Massachusetts, Minnesota, New Jersey, New York, Rhode Island, and Wisconsin.

Sporadic cases have been reported in Canada.

Europe and Asia

Babesiosis is also well documented in Europe and parts of East Asia. It is distributed throughout forested areas. In Europe, cases are reported in Ireland, the U.K., France, Germany, Austria, Belgium, Finland, and Italy. In Asia, cases are reported from Japan, Taiwan, China, and South Korea.

Human Granulocytic Anaplasmosis

The distribution of human granulocytic anaplasmosis (HGA) is likely broader than that reported.

North America

In the U.S., there are 3 regions of high anaplasmosis activity: the area from Maine to Maryland on the East Coast, Wisconsin and Minnesota in the Midwest, and northern California and Oregon on the West Coast. The center of the country exhibits little or no risk of transmission. There has been an increase in annual incidence from 1.4 cases/million persons in 2000 to 6.1 cases/million persons in 2010. Seroepidemiology studies suggest many infections are asymptomatic (15-36% of population in endemic areas are infected), and 10% have co-infection with Lyme or *Babesia*.

In Canada, anaplasmosis is a known zoonosis but is rarely reported in humans.

Europe and Asia

Laboratory-confirmed cases of anaplasmosis have been reported in Austria, Italy, Latvia, the Netherlands, Norway, Poland, Slovenia, Spain, France, Russia, and Sweden.

Seroepidemiologic studies have found a much broader distribution, with most infections being asymptomatic and with clinical cases having milder illness than in the U.S. A small number of cases have been reported in China.

Human Monocytic Ehrlichiosis

North America

In the U.S., the high transmission regions are the southeastern and south central states, with highest reported rates from Mississippi, Oklahoma, Tennessee, Arkansas, and Maryland. The estimated average incidence of human monocytic ehrlichiosis (HME) in the U.S. is 0.7 cases/million population, but in endemic areas incidence is at least 100-200 cases/100,000 population. Seropositivity of children residing in endemic areas is 20% without symptomatic disease. *E. ewingi* is a rare cause of HME.

Cases of HME have not been reported in Canada.

Worldwide

Ehrlichiosis is reported from several countries in Europe. Serologic and molecular testing have found *E. chaffeensis* to be present in Mexico, Venezuela, Brazil, Chile, South Korea, China, Croatia, Poland, Greece, and Italy, as well as parts of Africa.

MODE OF TRANSMISSION

Babesiosis

The protozoan parasites *Babesia* infect red blood cells through *Ixodes* tick bites. In the northeastern U.S. and the upper Midwest, the vector is *Ixodes scapularis* (blacklegged tick or deer tick), and most infections are transmitted from June to August. In the Pacific Northwest, the vector is *Ixodes pacificus* (western blacklegged tick).

In Europe, the vector is *Ixodes ricinus* (castor bean tick), and in Asia, *Ixodes persulcatus*. Both adult and

nymphal ticks can transmit disease. Transfusion-associated cases have occurred, as well as congenital transmission.

Anaplasmosis

The tick vectors are the same as those that transmit Lyme disease and babesiosis, and co-infection can occur. Peak transmission is June to August. In the northeastern U.S. and the upper Midwest, the vector is *Ixodes scapularis* (blacklegged tick or deer tick). In the Pacific Northwest, the vector is *Ixodes pacificus* (western blacklegged tick). In Europe, the vector is *Ixodes ricinus*, and in Asia, *Ixodes persulcatus*.

Ehrlichiosis

In the U.S., the vector is *Amblyomma americanum* (lone star tick). Peak transmission occurs from May through August.

EPIDEMIOLOGY

Babesiosis

The *Babesia* species infecting humans include *B. microti*, *B. divergens*, *B. venatorum*, *B. duncani*, and several others. Wild rodents and cattle are the zoonotic reservoir for the parasites and their vector ticks. Deer and other animals also serve to maintain and spread the vectors. In North America, adult ixodid ticks parasitize deer. The distribution of deer and the numbers of ticks are increasing steadily. Nymphal stages feed on rodents, especially white-footed mice, which are an important reservoir of infection. Dogs may bring ticks indoors.

Anaplasmosis

Wild rodents, including the white-footed mouse in the eastern U.S., and cattle are the zoonotic reservoirs for the parasites and their vector ticks. Deer and other animals also serve to maintain and spread the vectors.

Ehrlichiosis

White-tailed deer are persistently infected and serve as a reservoir of both *Ehrlichia chaffeensis* and *E. ewingi*. Co-infection can occur with *Rickettsia rickettsii*, because the geographic distribution of the tick vectors overlap. Other reservoirs may rarely include dogs and coyotes.

RISK FACTORS

Travelers at high risk for acquiring tick-borne diseases are those who engage in outdoor activities such as hiking and camping in forested or brushy areas, or gardening near such areas, where tick reservoirs abound.

- In North America, deer and mice are important reservoirs of infection. In addition, dogs may bring ticks indoors.
- In Europe, forestry, hunting, farming, mushroom collecting, berry picking, camping, and hiking are also high-risk activities. Small and medium-sized rodents throughout woodlands and forest and some species of birds are more important reservoir hosts than are sheep or deer.

Babesiosis, anaplasmosis, and ehrlichiosis are typically acquired during the summer months, when ticks are most active and human outdoor presence is highest.

Conditions that increase risk for severe disease include older age, asplenia, immunosuppressed host, and hepatic or renal disorders.

CLINICAL PRESENTATION

Clinical presentation can range from asymptomatic to severe and life-threatening. Severe disease can occur in asplenic persons, persons who are immunosuppressed or who have underlying hepatic or renal disorder, and the elderly.

Babesiosis

Some patients are asymptomatic but illness may occur after an incubation of 1-4 weeks. Symptoms may be nonspecific and flu-like, including fever, chills, sweats, headache, myalgia, anorexia, nausea, and fatigue. More severe illness may involve hypotension, hemolytic anemia, thrombocytopenia, disseminated intravascular coagulation, multi-organ failure, and death. In Europe, babesiosis is usually diagnosed in asplenic persons. Most cases occur in older adults (mean age 62 years). This protozoan resembles malaria microscopically.

Anaplasmosis

HGA has an incubation period of 1-2 weeks. Symptoms may include fever, chills, headache, myalgia, malaise, nausea, abdominal pain, cough, confusion, and, rarely, a rash (< 10%). Severe illness may include respiratory distress, hemorrhage, renal failure, or neurological complications. Case fatality rate is < 1%. Most cases occur in older adults (median age 51 years).

Ehrlichiosis

HME can cause life-threatening infections in humans and has an incubation period of 1-2 weeks. Symptoms may include fever, chills, headache, malaise, myalgia, nausea/vomiting/diarrhea, confusion, conjunctival injection, and skin eruption (in 66% of children and 21% of adults). The rash is not pruritic, may be an erythroderma, maculopapular, or petechial, and may spread to palms and soles. Respiratory failure, cardiovascular failure, hemorrhages, aseptic meningitis, meningoencephalitis, and hepatic failure can develop in severe cases. Case fatality rate is up to 3%. HME is generally a more severe disease than HGA. Most cases occur in older adults (median age 53 years).

PREVENTION STRATEGIES

Tick avoidance is the best strategy to prevent babesiosis, anaplasmosis, and ehrlichiosis.

People living in or entering tick-infested areas should be advised to:

- Wear long, light-colored pants tucked into socks.
- Use a DEET insect repellent on skin and an insect repellent containing permethrin on clothes.
- Check for ticks daily.
    - Each evening while in a risk area, and again after leaving the area, for adult ticks and nymphs, especially on the neck, scalp, groin, armpits, and belly-button are recommended.
    - Repeat the inspection daily and for a few days after leaving the area.

    - Pets should also be inspected, especially in the ears.
- Remove attached ticks immediately with fine-tipped tweezers, grasping the tick as close to the skin surface as possible and pulling directly upwards, steadily, without twisting or jerking.
    - Clean the site with an alcohol swab or soap and water.
    - Avoid handling the tick with bare hands.
- If possible, hikers should stay on well-cleared trails when crossing wooded areas.

These precautions reduce but do not eliminate the risk of tick bites and of acquiring babesiosis, anaplasmosis, or ehrlichiosis.

NEED FOR MEDICAL ASSISTANCE

Ticks found attached to a person's body should be promptly removed as described above (see *Infestations in Travelers*) and ideally should be saved in a glass container for later identification.

Some infections with *Babesia*, *Anaplasma*, or *Ehrlichia* can be difficult to diagnose, and potentially fatal complications can arise during the course of the illness.

Therefore, after a tick bite in areas of high endemicity, travelers with symptoms noted above should seek medical attention, especially if they are asplenic, elderly, or immunosuppressed; treatment with doxycycline may be indicated for persons with anaplasmosis or ehrlichiosis. (Unlike Lyme disease, there is no recommendation for prophylactic use of doxycycline for anaplasmosis or ehrlichiosis.)

Laboratory testing can confirm the diagnosis of tick-borne infections. In the acute stage (first week of illness), peripheral blood smear and molecular testing (PCR) can be positive. After the initial 7-10 days, serology (IgM and IgG) may become positive; if negative tests occur during acute illness, convalescent titers are required to interpret the results.

Disease	Etiology	Tick Vector	Distribution: high risk
Babesiosis	*Babesia microti*	Blacklegged tick (*Ixodes*)	U.S. (Northeast, upper Midwest); E U.K., France, Austria, Italy, Germa Finland); Asia (Japan, Taiwan, Ch Korea)
Anaplasmosis (HGA)	*Anaplasma phagocytophilum*	Blacklegged tick (*Ixodes*)	U.S. (Northeast, upper Midwest); E (Slovenia, Sweden); Asia (China, S Korea)
Ehrlichiosis (HME)	*Ehrlichia chaffeensis, E. ewingii, E. muris*-like and other species	Lone star tick (*Amblyomma americanum*)	U.S. (eastern and south central); M America; Europe (widespread); As possibly Africa