Biomedical and Health Informatics
Vol. 1, No. 2, 2016, pp. 44-51
http://www.aiscience.org/journal/bhi

Medical Importance of Ticks Bite and Diseases Transmission by Means of It Affecting Humans

Muhammad Haroon Sarwar[1, *], Muhammad Sarwar[2]

[1]Allied Hospital- Punjab Medical College, Faisalabad, Punjab, Pakistan
[2]Department of Entomology, Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar, Pakistan

Abstract

This article offers a practical tool for those who are looking for information on ticks, especially when the highest risk of their being bitten occurs in humans. The information includes particular stages of the different tick species, predilection sites for each stage and also a summary of their biology, hosts and importance as vector of pathogens causing diseases of humans and animals. Ticks are attached to the body of host for a blood meal and cause mechanical injury by insertion of mouth parts into the skin resulting irritation and serious physical damages to body. Feeding by large numbers of ticks causes unrest, the direct injury to skins due to tick bites, loss of blood due to the nourishing of ticks and weight loss due to massive infestation of ticks. Like any ticks, Ixodes species may cause irritation and pruritus around attachment sites, and secondary infections can develop at tick attachment spots, leading to sepsis. Of the many different tick species found throughout the world, only a few selective species can bite and transmit disease to humans. The highest risk of being bitten occurs during spring and summer by american dog tick (*Dermacentor variabilis*), blacklegged tick or deer tick (*Ixodes scapularis*), brown dog tick (*Rhipicephalus sanguineus*), gulf coast tick (*Amblyomma maculatum*), lone star tick (*Amblyomma americanum*), rocky mountain wood tick (*Dermacentor andersoni*), western blacklegged tick (*Ixodes pacificus*), pacific coast tick (*Dermacentor occidentalis*) and cayenne tick (*Amblyomma cajennense*). They rank second only to mosquitoes as vectors of life threatening or debilitating human and animal diseases caused by protozoa, rickettsiae, bacteria, viruses and helminths. Personal protection, and use of repellents and acaricide impregnated clothing are recommended methods to minimize contact with infected ticks. Controlling of tick infestations can be difficult and usually requires a four step process, treating the pets, treating the house, treating the yard and sanitizing the house by focusing on vacuuming. This process may take several treatments and proceed several months to eradicate the ticks infestation. Pets not treated with acaricides may bring ticks into the home which can then move to peoples and other animals, thus, creating a risk of infection. Keeping of pets maintained with acaricides, creates a safer environment for the animals and peoples. Vaccinating of pets for diseases in areas where ticks are endemic or emerging in addition to diligent attention to tick control on pets and in the environment, can provide the most comprehensive protection against the many diseases transmitted by these vectors.

Keywords

Tick Identification, Tick Bite-ology, Tick Activity, Tick Notes, Tick Repellent

Received: July 25, 2016 / Accepted: August 5, 2016 / Published online: December 27, 2016

1. Introduction

Ticks belong to phylum Arthropoda and make up the largest collection of creatures in order Acarina. The medical and economic importance of ticks has long been recognized due to their ability to bite and transmit diseases to humans and animals. Feeding by large numbers of ticks causes reduction in live weight and anemia among domestic animals, while tick bites also reduce the quality of hides. Apart from

* Corresponding author
E-mail address: mharoonsarwar92@gmail.com (M. H. Sarwar)

irritation or anemia in case of heavy infestations, ticks can cause severe dermatitis on hosts. These parasites generate direct effects in cattle in terms of milk production and reduce in weight gain (L′Hostis and Seegers, 2002; Peter et al., 2005). Physically, ticks are attached to the body of vertebrates for a blood meal and may cause irritation and serious physical damages to skin. Ticks incidence includes 'tick worry', irritation, unrest and weight loss due to massive infestation, the direct injury to hides due to tick bites, and loss of blood due to the feeding of ticks. Mechanical injury due to insertion of mouth parts into the skin and salivary secretion of ticks causes blood haemolysis. Ticks live and hide in low lying bushes and shrubs, wherein these locations allow them to physically contact the hosts. One study suggests that leaning against a tree or sitting on an old log is the quickest way to acquire ticks (within about 30 seconds) in tick-infested areas. Ticks require a 'blood meal' to grow and survive, and they are not very particular about on whom or what they feed, otherwise if ticks do not find a host, they may die. Once a tick finds a host (such as human, pet dog or cat, deer, or rabbit) and catches a suitable site for attachment, the tick begins to burrow with its mouthparts into exposed skin. Tick mouthparts are barbed, which help to secure them to the host. Often the tick secretes 'cementum' to more firmly attach its mouthparts and head to the host. Ticks may secrete or regurgitate small amounts of saliva that contain neurotoxins. These nerve poisons cleverly prevent the host from feeling the pain and irritation of the bite. Consequently, individuals may never notice the tick bite or its feeding. The saliva may contain a blood thinner to make it easier for the tick to get its blood meal. Some peoples are allergic to these secretions and may have a quick and severe allergic reaction to a tick bite and few may develop other symptoms as illness (Piesman and Happ, 1997; Cilek and Olson, 2000).

2. Ticks That Bite Humans

The medical and economic positions of ticks have long been familiar owing to their abilities to bite and transmit diseases to humans and animals. The hard ticks are distinguished by a dorsal shield, which is small in the female, but in the male it covers the entire dorsal surface. Hard ticks are also tapered anteriorly and the mouthparts are readily visible from the dorsal view (Sarwar, 2016). Of the many different tick species found throughout the world, however, only a few bite to humans as described below:-

2.1. American Dog Tick (*Dermacentor variabilis*) (Say)

American dog ticks are also sometimes called wood ticks, both males and females have pale whitish or yellowish markings on the scutum or dorsal shield. Adult females are most likely to bite humans and the highest risk of being bitten occurs during spring and summer. Dog ticks are found predominantly in areas with little or no tree cover, such as grassy fields and scrubland, as well as along walkways and trails. They feed on a variety of hosts, ranging in size from mouse to deer, and nymphs and adults can transmit diseases such as rocky mountain spotted fever and tularemia. Dog ticks can survive for up to 2 years at any given stage if no host is found. Females can be identified by their large off-white scutum against a dark brown body. Adult american dog ticks commonly attack humans. Male ticks feed on blood briefly, but do not become distended with blood. Once feeding is finished, males mate with the female while it feeds, which can take one week or more. Once full, females dog ticks detach from their host and drop into the leaf litter, where they can lay over 4,000 eggs before dying. Nymphal dog ticks rarely attach to humans, and once engorged, nymphs detach from their host, falling into the grass or meadow straw and leaf litter where they molt into adults. After blood feeding for 3 to 4 days, larvae detach from their host, falling into the grass or meadow thatch and leaf litter where they molt into nymphs (Piesman and Christine, 1997; Holden et al., 2003).

2.2. Blacklegged Tick or Deer Tick (*Ixodes scapularis*) (Say)

Adult blacklegged or deer ticks are found predominately in deciduous forest and their distribution relies greatly on the distribution of their reproductive host, white-tailed deer. The males and females are dark brown in color and have no white markings. Tick females readily attack humans and pets. Once females fully engorge on their blood meal, they drop off the host into the leaf litter, where they can over-winter. Engorged females lay a single egg mass (up to 1500-2000 eggs) in mid to late May, and then die. Larvae emerge from eggs later in the summer. Unfed female blacklegged ticks are easily distinguished from other ticks by the orange-red body surrounding the black scutum. The eight-legged, pin-head sized nymph typically attaches to smaller mammals such as mice, voles and chipmunks, requiring 3-4 days to fully engorge. Nymphs also readily attach to host and blood feed on humans, cats and dogs. Once fed, they drop off into rodent burrows or leaf litter in animal bedding areas where they molt and emerge as adults in the fall. Larvae hatch nearly pathogen-free from eggs (only *Borrelia miyamotoi* is known to infect blacklegged tick larvae), and remain in the leaf litter where they attach to nearly any small, medium or large-sized mammal and many species of birds, but preferred hosts are white-footed mice. Larvae remain attached to their host until replete, which usually requires 3 days. Once fully engorged, the larvae drop off of the host and molt, and re-emerging the

following spring as nymphs. Both nymph and adult stages transmit diseases such as lyme disease, anaplasmosis, babesiosis and powassan disease. The greatest risk of being bitten exists in the spring, summer and fall. However, adults may be out searching for a host any time even when winter temperatures are above freezing point. Stages most likely to bite humans are nymphs and adult females (Suzuki and Grady, 2004; Brownstein et al., 2005).

2.3. Brown Dog Tick (*Rhipicephalus sanguineus*) Latreille

They occur predominately in and around human settlements and infest homes, animal pens, and dog kennels, often causing high levels of infestation both on dogs and in homes. These ticks can spend their entire life cycle indoors and is a reddish-brown species. Adult males and females can be found at all times of the year and can survive for 18 months without feeding. After digesting the blood meal, female brown dog ticks can lay up to 4,000 eggs on top of kennels, on ledges, or in cracks and crevices in or around a house. Larvae hatch from eggs in 2 to 5 weeks and nymphs also can be found at all times of the year and survive for 6 to 9 months without a blood meal. Nymphs blood feed for five to ten days, and after detaching from the host engorged nymphs typically hide in and around furniture, windows, edges of rugs, house siding and foundations, and they take about two weeks to develop into adult stage ticks. Like the adult and nymphal stages, six-legged larvae prefer to feed on dogs, but will feed on other mammals and occasionally humans. Larvae blood feed for three to seven days before detaching from the host and take about two weeks to develop into nymphs. All life stages of this tick can transmit rocky mountain spotted fever and rickettsia (*Rickettsia rickettsia*) to dogs, and rarely to humans. Dogs are the primary host for the brown dog tick in each of its life stages, but the tick may also bite humans or other mammals (Otranto and Dantas-Torres, 2010).

2.4. Gulf Coast Tick (*Amblyomma maculatum*) Koch

Adults *Amblyomma maculatum* tick live in areas with shrub vegetation and since it is vulnerable to desiccation in areas that do not have enough humidity or too much wind, they seek out sheltered areas with good shade cover and relatively high amounts of humidity. The ticks have flat eyes, spurs on their fourth coxa that do not quite reach the anus level, and they also contain a single external spur and an indistinct internal spur on the first coxa. The males have a complete marginal groove between their antennas which the females lack, but the females have a glabrous notum while males do not. The larvae of the *A. maculatum* have broad oval bodies which are widest around the posterior and middle, and covering their bodies with several different pairs of sensilla. For the genus Amblyomma, a female prepares for reproduction by partially engorging itself and then slowing its feeding rate until mating. Mating occurs through the transfer of a spermataphore from the male to the female via the male's mouth parts and the female's vagina that drops off the host in order to lay its eggs anywhere from 15,000 to 23,000 eggs at a time. The *A. maculatum* is a three host tick, the tick starts life as a larva that parasitizes small birds and then molts into its nymph stage that parasitizes small ground mammals. Finally the tick once again molts into its final adult stage which is sexually active and parasitizes larger mammals. The primary behavior in all life stages of *A. maculatum* is to seek a host, where a tick goes to the top of a plant or leaf and extends its front legs, and can be found on species of Equidae, Canidae and Bovidae though they usually prefer larger ungulates. The larval stage attaches mainly to ground dwelling birds, while the nymphs prefer to smaller mammals and humans can be parasitized by this tick. The most likely economic damage that *A. maculatum* potentially causes is its vectoring of various diseases like *R. parkeri* that is a form of spotted fever to humans, and *Hepatozoon americanum*. These diseases can affect people's ability to work, produce goods, and take time and money to treat (Ketchum et al., 2005; Lohmeyer et al., 2009; Florin et al., 2013).

2.5. Lone Star Tick (*Amblyomma americanum*) (Linnaeus)

Lone star ticks are reddish-brown species, and found mostly in woodlands with dense undergrowth and around animal resting areas. Females are easily recognized by a single white dot in the centre of a brown body, with the males having spots or streaks of white around the outer edge of the body. Females require 1 week to 10 days or more to engorge and can lay 2,500-3,000 eggs. Where abundant, nymphs seemingly swarm up pant legs and can become attached in less than 10 minutes. Nymphs typically take 5-6 days to become replete, and once fully engorged, they fall off of the host into the leaf litter, where they molt into adults. Larvae are active in July- late to September and can be found questing for a wide variety of animals, including cats, dogs, deer, coyotes, raccoons, squirrels, turkeys, and some small birds. After feeding for around 4 days, they drop off of the host and bury themselves in the leaf litter, where they molt into nymphs. The larvae do not carry disease, but the nymphal and adult stages can transmit the pathogens causing monocytic ehrlichiosis *Ehrlichia chaffeensis* and *E. ewingii* (which cause human ehrlichiosis), rocky mountain spotted fever, tularemia and borreliosis. Lone star ticks are notorious pests, and all stages are aggressive human biters, its saliva can be irritating, but redness and discomfort at a bite site

does not necessarily indicate an infection. The nymph and adult females most frequently bite to humans and transmit disease (Childs and Paddock, 2003; Ledin et al., 2005).

2.6. Rocky Mountain Wood Tick (*Dermacentor andersoni*) Stiles

Rocky mountain wood ticks are found predominantly in shrub lands, lightly wooded areas, open grasslands and along trails, mainly at lower elevations. All life stages of this tick can transmit colorado tick fever virus to humans, rocky mountain spotted fever rickettsia (*R. rickettsii*) and agent of tularemia (*Francisella tularensis*) to a variety of hosts, including humans, cats and dogs. Rocky mountain wood tick's saliva contains a neurotoxin that can occasionally cause tick paralysis in humans and pets, and usually a bite from an adult female induces an ascending paralysis that dissipates within 24-72 hrs after tick removal. These ticks typically take two to three years to complete their life cycle. Adult wood ticks survive for up to 600 days without feeding and prefer to feed on medium to large mammals, and can be found questing about knee high on the tips of vegetation. Males only blood feed for short periods of time to initiate spermatogenesis, after which they seek to attach to and mate with female ticks. Female wood ticks feed for 4-17 days before dropping off their host and laying up to 6,000 eggs. Once attached to a host, nymphal wood ticks take 3-11 days to feed to repletion. After consuming a full blood meal from their host, nymphs detach and can develop into the adult stage in as little time as two weeks. Larvae can hatch from eggs as soon as one to five weeks after egg laying and take two to eight days to feed to repletion. Once larvae have consumed a full blood meal they drop from their host and take one to three weeks to develop into nymphs. Larvae also may enter a diapause, induced either by diminishing day-length or unfavorable environmental conditions. Adult ticks feed primarily on large mammals, while larvae and nymphs feed on small rodents. Adult ticks are primarily associated with pathogen transmission to humans such as rocky mountain spotted fever, colorado tick fever and tularemia (Dergousoff et al., 2009).

2.7. Western Blacklegged Tick (*Ixodes pacificus*) Cooley and Kohls

The *Ixodes pacificus* ticks are most commonly found in the understory or leaf litter associated with natural wooded areas frequented by wildlife. The forest edge often found surrounding a home, yard, or public recreation area provides ample habitat to support these ticks. Tick abundance is based on the seasonal activity of the ticks in specific regions. Adult and nymph legs, head and thoracic plate are black; female abdomen dark reddish; male abdomen blackish; 8 legs nymph about half (less than 2 mm) as large as adult; and 6 legs larva, lighter color and about one-quarter (less than 1 mm) as large as adult (approximately 3 mm). Because different stages are active at different times, Ixodes spp., activity extends to include most of the year and can take two years for completion depending on environmental conditions. Adults may mate on or off a host, and once mated and fully engorged the females deposit a single clutch of approximately 1,500-3,000 eggs in the environment and then die. The larva must then find a host, feed for several days, and then drop to the ground and molt to an eight-legged nymph. The nymph then finds an appropriate host and feeds for several days to a week. Once the nymph has engorged, it drops to the ground and molts to the eight-legged adult, which then must find a third host. Nymphs often feed on lizards, as well as other small animals. As a result, rates of infection are usually low (1%) in adults. Stages most likely to bite the humans are nymphs and adult females, and adults feed on blood of large mammals such as deer, dogs, coyotes, horses and humans. Peoples become infested in the same way as their pets i.e., by encountering questing ticks in tick-infested habitats. The *I. pacificus* is the second most common Borrelia carrying and principally transmits anaplasmosis and lyme disease (Chang et al., 2001; Killilea et al., 2008).

2.8. Pacific Coast Tick (*Dermacentor occidentalis*) Marx

Pacific coast ticks are human-biting ticks with a broad host range, found predominantly in shrub lands and can be easily confused with other less common Dermacentor ticks (*D. variabilis* and *D. andersoni*). The males attach to mammals and feed for short periods of time to initiate spermatogenesis, but females feed for 6-10 days before dropping off their host and laying eggs. Eggs are laid about 3 weeks after the engorged adult female detaches. Nymphs prefer to feed on small rodents and other small mammals, especially squirrels. Nymphs can be found questing for hosts on the ground or up to five inches from the ground on the sides of vegetation. Once nymphs have consumed a full blood meal (about 6 days) from their host, they detach and take between 15- 25 days to develop into adult males and females. Larvae of ticks can hatch from eggs in about a month and prefer to feed on small rodents and other small mammals, typically taking 4 days to engorge. Once the larvae have consumed a full blood meal from their host, they detach and take about 2 weeks to develop into nymphs. All life stages of this tick can transmit rocky mountain spotted fever (*R. rickettsii*) to humans, cats and dogs. Nymphs and adults can transmit 364D rickettsiosis (*Rickettsia phillipi*) to humans, tularemia (*F. tularensis*) to humans, cats and dogs, and bovine anaplasmosis to cattle (Sonenshine, 1993).

2.9. Cayenne Tick (*Amblyomma cajennense*) (Fabricius)

The body of cayenne ticks is mottled brown in color, with a large black region on the abdomen of adult females. The hypostome is specially adapted for attachment to the host and this structure is inserted deeply into the host and attached firmly with a glue-like substance secreted from the salivary glands. Male cayenne ticks produce pheromones in order to attract females to the host animal on which they are feeding. In mating females, the abdomen may grow to many times than its original size following feeding, which a phenomenon is called engorgement during which their body swells to roughly 0.6 to 1.0 g. Clutch sizes for hard-bodied ticks range from hundreds to 20,000 or more eggs per female. Eggs hatch in 5 to 7 weeks and nymphs molt and enter the adult stage. Total time of development varies with temperature and availability of hosts. The complete cycle from egg to questing adult usually takes about 6 months. Like other members of Ixodidae, cayenne ticks are commonly found in grassy areas where they may encounter horses that are preferred hosts and occasionally occur in wooded areas, where nymphs parasitize various species of birds. This multiple host behavior leads to a high risk of pathogen spreading, most notably the disease rocky mountain spotted fever, which is caused by the bacterium *R. rickettsii* (Labruna, et al., 2008; Ogrzewalska, et al., 2009). The saliva of cayenne ticks is currently being studied for medicinal purposes. It contains a protein known as Factor X Active, which may be beneficial in treating of blood clots and cancer (Batista, et al., 2010).

Ticks bite and parasitize a wide range of vertebrate hosts, and transmit a wider variety of pathogenic agents than any other group of arthropods. There are 899 tick species those parasitize the vertebrates including Argasidae (185 species), Ixodidae (713 species) and Nuttalliellidae (1 specie) (Barker and Murrell, 2004; Demma et al., 2005; Eremeeva et al., 2006; Harry et al., 2013).

3. Tick Bite Symptoms and Signs

Tick bites are generally painless, many peoples may not even notice the bite and may never find the tick if it falls off. Small ticks, like the deer tick that transmits lyme disease, are so tiny that they may be nearly undetectable. However, there are some symptoms that may occur and can be directly related to the tick itself as they are due to the tick bite. Occasionally, a neurotoxin (a substance that is toxic to nerves) secreted at the time of attachment to make the bite unnoticeable to humans and other hosts can cause muscle weakness or paralysis. It rarely causes paralysis that inhibits breathing and the simple task of removing the tick stops any further neurotoxin production, and the person usually recovers quickly and completely. The actual bite may cause symptoms only after the tick drops off. However, some peoples may notice local redness, itching, burning and rarely localized intense pain (soft ticks) before or after the tick drops off. The majority of tick bites result in few, if any, immediate symptoms. However, saliva from the lone star tick has been linked to allergic reactions to red meats (beef or venison, for example) and milk allergy may also occur. Researchers suggest an alpha-gal sugar antigen is secreted with tick saliva into humans that produce an immune response to similar antigens in red meats. When red meats are eaten, the immune system responds by causing swelling, hives and even anaphylactic shock.

The results of the illnesses or pathogens transmitted by ticks often begin days to weeks after the tick is gone. That is why physicians or affected individuals may not suspect a tick-related illness because many peoples are not aware of the bites or ignore or forget about barely noticeable bites. The most important clue about any tick-related illness is to tell the physician about a tick bite. Also, the individual needs to tell their physician about outdoor activity (camping, hiking, etc.), in tick-infested areas even if the person does not remember a tick bite. After a tick bite, individuals may develop any of the symptoms that may be due to the organism that the tick transmits during its bite, such as flu-like symptoms, fever, numbness, rash (these vary according to the pathogen transmitted by the tick), confusion, weakness, pain and swelling in the joints, palpitations, paralysis, shortness of breath, and nausea or vomiting. These symptoms may appear with many different types of tick bites, specific conditions and different pathogens passed into the host by ticks.

4. Seek to Medical Care

Call or see a physician if any of the conditions exist such as person or child bitten by a tick exhibits any weakness, paralysis, lethargy, confusion, fever, numbness, headache, or rashes. When the tick cannot be removed from the skin, or the head and mouthparts remain in the skin after removal, then symptoms may persist or get worse. Pregnant women should inform their physicians about tick bites and particularly before they take any medications. Immunosuppressed individuals (for example those with HIV (human immunodeficiency virus) or cancer or who are receiving cancer chemotherapy) should also inform their physicians of tick bites. Go immediately to a hospital's emergency department if a tick bite causes any of the symptoms like fever, headache, confusion, weakness or paralysis, numbness, vomiting, difficulty in breathing and

palpitations.

5. Tick Bite Diagnosis

There are no tests that can identify either tick bites or the type of tick once the tick dislodges from the body of host. However, physicians can conduct a careful examination of the entire body, looking for ticks still attached, rashes, or signs of a tick-caused disease. If the tick is identified, the physician can better determine what tests should be done. Identification of the tick genus and species may help the physician to determine what further tests may be appropriate. For example, blood tests for diseases such as lyme disease, rocky mountain spotted fever, ehrlichiosis, and tularemia are generally not positive for weeks after the exposure, even though symptoms may be present, and examination of blood under a microscope is necessary to diagnose the parasite that causes babesiosis. Knowledge of the type of tick that caused the bite can help to narrow the physician's list of possible diagnoses and even allow the physician to proceed with early therapy before a positive diagnosis is made. Examination and tests should be done if an individual exhibits symptoms after a tick bite as most tick bites do not result in symptoms. If symptoms develop after a tick bite, the determination of which tests need to be performed is best done in consultation with an infectious-disease specialist.

6. Self-Care at Home

Unfortunately, many peoples think that they know how to remove ticks, but most common tick-removal methods can result in increasing the chances of infection. The greatest concern in removing a tick can be result in the possibility of transmission of disease. Methods of removal that stimulate the tick to spit out even small amounts of their blood meal, or to pass infected saliva back into the host, may increase the likelihood of disease transmission. Once removed, do not crush the tick because it may transmit disease. Keep it in a tightly closed jar or taped to a piece of paper and show the tick to the physician if person become ill from the tick bite. The area of the bite should leave a small crater or indentation where the head and mouthparts are embedded. If portions of the head or mouthparts remain in body, they should be removed by the physician. Thoroughly clean the bite area with soap and water or a mild disinfectant. Observe the area for several days for development of a reaction to the bite, such as a rash or signs of infection. Apply first-aid antibiotic cream to the area. Application of an antibiotic to the area may help in preventing a local infection, but usually does not affect the chance of developing diseases transmitted by the tick. Remember to wash hands thoroughly after handling any tick or instruments that touched a tick, and clean and disinfect any instruments that are used.

7. Tick Bite Treatment

The treatment of a given tick exposure depends on the length of attachment, type of tick, tick-borne diseases that have been seen in the community (for example, lyme disease), and the symptoms developed by the person. Specific medical treatment depends on the pathogen transmitted in the tick bite. For treatments, local cleansing and antibiotic cream may be applied, and for itching, the physician may recommend preparations containing diphenhydramine (Benadryl). Benadryl compounds can be applied directly to the skin for itching or administered orally by tablets. Oral antibiotics may be prescribed for some diseases, and with more significant symptoms, it can need antibiotics given through an IV and may need to be hospitalized. Other treatments may involve more detailed blood tests, fluids and medications given by IV (intravenous therapy), and admission to the hospital. For detailed explanations of treatments, the best approach is to determine the diagnosis of the disease transmitted by the tick bite (for example, rocky mountain spotted fever, lyme disease) and then examine the specific treatments used for that disease.

8. Tick Bite Prevention

Avoid grassy areas and shrubs where ticks may be lying in wait to tag a ride on a potential meal, and avoid tick season completely by staying away from outdoor areas where ticks thrive. Wear light-coloured clothing so that ticks can be easily seen, and brush them off. Tuck pants into boots or socks and shirt into pant. Apply insect repellent, specifically the brands designed to repel ticks and follow label instructions. Carefully follow instructions and apply some repellents directly to skin and others to clothing. The DEET-containing repellents with concentrations of 15% or less may be suitable for children and should be carefully applied following the package label instructions. Promptly, check oneself, others and pets if exposed to tick areas. Make sure to treat pets with flea and tick repellents. If ticks are removed from pets, manage them in the same way as a tick is removed on a person and protect oneself from the potential exposures with gloves. Pet owners should be aware about the toxicity of the repellents as small pets may be died as a result of overexposure to the tick repellents. Peoples who live in a tick-infested area and have experienced a fever within the last two months should not donate blood. There is no vaccine against ticks, but ongoing research suggests that a type of white blood cell (basophils) may play a role in resistance to tick bites. Area-wide application of acaricides (chemicals that will kill ticks and mites) and reduction of tick habitats (leaf

and litter) have been effective in small-scale trials. New methods of control include applying of acaricides to animal hosts by using baited tubes, boxes and feeding stations in areas where infected ticks are endemic.

9. Tick Bite Prognosis

Most tick bites are probably harmless and may cause no problems, but ticks that have never fed, if handled properly, can not cause any harm. The earlier a tick is removed, the less is the likelihood that the tick can transmit any disease. If there is any immediate reaction to a tick bite and if the tick is removed expeditiously, most individuals recover almost immediately. The outlook (prognosis) of the diseases transmitted by tick bites can range from good to poor, once a diagnosis is made, the prognosis is best determined by the diagnosing physician and is related to the disease that is transmitted by the tick and the stage of development of the disease process in the individual at the time of diagnosis and treatment.

10. Effective Ways to Avoid Tick Bites

There are many effective ways to avoid tick bites and infestations, as a result, this guide will share the knowledge on some effective ways of avoiding tick bites and infestations.

10.1. Avoiding Trails and Wooded Areas

The majority of tick infestations occur in the summer in heavily wooded areas and grassy trails. The nymphs and larvae of deer ticks are active during spring and early summer while adults may remain active during winter and fall as well. To avoid getting bitten, it is the best practice to minimize frequent walks in the peak season activities of culprits.

10.2. Choosing Cleared Areas for Trails

Deer ticks climb on their human hosts through direct contact only and they do not fall or drop on them. Once they come in contact with humans, they crawl until these find a shaded protective spot. So, the best way to avoid tick infestations is to walk on less dense, non-wooded, less bushy and well-travelled trails only.

10.3. Checking Ourselves Frequently

Workers or hikers who spend time in tick infested areas must check each other frequently for presence of ticks. They must avoid sitting down in areas having grass piles or leaf litter as this is a sure fire way of inviting ticks.

10.4. Checking of Hair

Ticks can also come in contact with humans through one's hair, so, it is best to keep long hair braided and tucked inside a scarf or a hat. Once persons come to home, should dust the hair and shower immediately to remove hidden ticks if any present.

10.5. Washing of Clothing

Once persons are back after visiting heavily tick infested areas, then toss all clothing in the dryer on its hottest setting for a minimum of 20 minutes. Also shower immediately to avoid tick bites from hidden ticks.

10.6. When Get Bitten

Tick bites must not be ignored and make sure to wash the site of the bite with warm water and antibacterial soap solution. Also watch out for rashes, chills, fever, body aches etc., and if these signs are present, visit a physician immediately (Piesman and Eisen, 2008; Nagamori and Reichard, 2015).

11. Conclusion

This article provided information on ixodid ticks feeding on humans worldwide in view of increasing awareness of risks associated with their bites. Ticks can cause paralyses, toxicoses, allergic reactions and are vectors of a broad range of viral, rickettsial, bacterial and protozoan pathogens. Tick-borne diseases of humans are a major public health concern, notably, those of viral origin, characterized by encephalitis and hemorrhagic fevers, and cause the highest morbidity and mortality. Consequently, personal protection methods, especially wearing of protective clothing and spraying with acaricides and the use of repellents, are advised to minimize contact with infected ticks. Acaricidal control of ixodid ticks is impractical because of their wide distribution in forested areas, but houses infested with ticks can be sprayed with acaricidal formulations. Attached ticks should be removed without delay and the best way is to grasp the tick as close to the skin as possible with fine tweezers and pull firmly and steadily without twisting. Finally, considerable interest might exist to investigate several parasitological and epidemiological aspects of ticks involved in human parasitism.

References

[1] Batista, I., Ramos, O., Ventura, J., Junqueira-de Azevedo, I. Chudzinski-Tavassi, A. and Ho, P. 2010. A new Factor Xa inhibitor from *Amblyomma cajennense* with a unique domain composition. Archives of Biochemistry and Biophysics, 493: 151-156.

[2] Brownstein, J. S., Holford, T. R. and Fish, D. 2005. Effect of Climate Change on Lyme Disease Risk in North America. EcoHealth, 2 (1): 38-46.

[3] Chang, C. C., Chomel, B. B., Kasten, R. W., Romano, V. and Tietze, N. 2001. Molecular evidence of *Bartonella* spp. in questing adult *Ixodes pacificus* ticks in California. J. Clin. Microbiol., 39 (4): 1221-1226.

[4] Childs, J. E. and Paddock, C. D. 2003. The ascendancy of *Amblyomma americanum* as a vector of pathogens affecting humans in the United States. Annual Review of Entomology, 48 (1): 307-337.

[5] Cilek, J. E. and Olson, M. A. 2000. Seasonal distribution and abundance of ticks (Acari: Ixodidae) in northwestern Florida. Journal of Medical Entomology, 37: 439-444.

[6] Dantas-Torres, F. 2010. Biology and ecology of the brown dog tick, *Rhipicephalus sanguineus*. Parasites and Vectors, 3 (26): 1-10.

[7] Demma, L. J., Traeger, M. S., Nicholson, W. L., Paddock, C. D., Blau, D. M., Eremeeva, M. E., Dasch, G. A., Levin, M. L., Singleton, J. J., Zaki, S. R., Cheek, J. E., Swerdlow, D. L. and McQuiston, J. H. 2005. Rocky Mountain spotted fever from an unexpected tick vector in Arizona. New England J. Medicine, 353: 587-594.

[8] Dergousoff, S. J., Gajadhar, A. J. and Chilton N. B. 2009. Prevalence of Rickettsia species in Canadian populations of *Dermacentor andersoni* and *D. variabilis*. Appl. Environ. Microbiol., 75 (6): 1786-1789.

[9] Eremeeva, M. E., Bosserman, A., Demma, L. J., Zambrano, M. L., Blau, D. M. and Dasch, G. A. 2006. Isolation and identification of *Rickettsia massiliae* in *Rhipicephalus sanguineus* ticks from Arizona. Appl. Environ. Microbiol., 72: 5569-5577.

[10] Florin, D. A., Ju, J., Richard, G. R. and Allen, L. R. 2013. Infection of the Gulf Coast tick, *Amblyomma maculatum* (Acari: Ixodidae), with *Rickettsia parkeri*: first report from the State of Delaware. Systematic and Applied Acarology, 18 (1): 27-29.

[11] Harry, M. S., Marvin, S., Godsey, J., Amy, L., Nickolas, A. P., Kristen, L. B., Jessica, R. H., Lash, R. R., David, C. A. and William, L. N. 2013. First Detection of Heartland Virus (Bunyaviridae: Phlebovirus) from Field Collected Arthropods. Am. J. Trop. Med. Hyg., 89 (3): 445-452.

[12] Holden, K., Boothby, J. T., Anand, S. and Massung, R. F. 2003. Detection of *Borrelia burgdorferi, Ehrlichia chaffeensis*, and *Anaplasma phagocytophilum* in Ticks (Acari: Ixodidae) from a Coastal Region of California. J. Med. Entomol., 40 (4): 534-539.

[13] Ketchum, H., Teel, P., Strey, O. and Longnecker, M. 2005. Feeding predilection of Gulf Coast tick, *Amblyomma maculatum* Koch, nymphs on cattle. Veterinary Parasitology, 4/ 5: 349-356.

[14] Killilea, M. E., Swei, A., Lane, R. S., Briggs, C. J. and Ostfeld, R. S. 2008. Spatial dynamics of lyme disease: a review. EcoHealth, 5 (2): 167-195.

[15] Labruna, L., Ogrzewalska, M., Martins, T., Pinter, A. and Horta, M. 2008. Comparative susceptibility of larval stages of *Amblyomma aureolatum*, *Amblyomma cajennense*, and *Rhipicephalus sanguineus* to infection by *Rickettsia rickettsii*. Journal of Medical Entomology, 45 (6): 1156-1159.

[16] Ledin, K. E., Zeidner, N. S., Ribeiro, J. M. C., Biggerstaff, B. J., Dolan, M. C., Dietrich, G., Vredevoe, L. and Piesman, J. 2005. Borreliacidal activity of saliva of the tick *Amblyomma americanum*. Medical and Veterinary Entomology, 19 (1): 90-95.

[17] L'Hostis, M. and Seegers, H. 2002. Tick-borne parasitic diseases in cattle: current knowledge and prospective risk analysis related to the ongoing evolution in French cattle farming systems. Vet. Res., 33 (5): 599-611.

[18] Lohmeyer, K., Pound, J. and George, J. 2009. Effects of photoperiod on reproduction, nymphal developmental timing, and diapause in *Amblyomma maculatum* (Acari: Ixodidae). Journal of Medical Entomology, 46/ 6: 1299-1302.

[19] Nagamori, Y. and Reichard, M. V. 2015. Feline tick-borne diseases. Today's Veterinary Practice, 5 (3): 69-73.

[20] Ogrzewalska, M., Pachecho, R., Uezu, A., Richtzenhain, L., Ferreira, F. and Labruna, M. 2009. Ticks (Acari: Ixodidae) infesting birds in an Atlantic rain forest region of Brazil. Journal of Medical Entomology, 46 (5): 1225-1229.

[21] Otranto, D. and Dantas-Torres, F. 2010. Canine and feline vector-borne diseases in Italy: current situation and perspectives. Parasites and Vectors, 3 (1): 2.

[22] Peter, R. J., Van den Bossche, P., Penzhorn, B. L. and Sharp, B. 2005. Tick, fly, and mosquito control- Lessons from the past, solutions for the future. Vet. Parasitol., 132 (3-4): 205-215.

[23] Piesman, J. and Christine, M. H. 1997. Ability of the Lyme disease spirochete *Borrelia burgdorferi* to infect rodents and three species of human-biting ticks (blacklegged tick, American dog tick, lone star tick) (Acari: Ixodidae). J. Med. Entomol., 34 (4): 451-456.

[24] Piesman, J. and Eisen, L. 2008. Prevention of tick borne diseases. Annu. Rev. Entomol., 53: 323-343.

[25] Piesman, J. and Happ, C. M. 1997. Ability of the Lyme disease spirochete *Borrelia burgdoferi* to infect rodents and three species of human-biting ticks (blacklegged tick, American dog tick, lone star tick) (Acari: Ixodidae). J. Med. Entomol., 34 (4): 451-456.

[26] Sarwar, M. 2016. Ticks (Arachnida: Acari) induced Paralysis in Humans and Control of Incidence in the Current Civilization. International Journal for Research in Social Science and Humanities Research, 1 (7): 27-36.

[27] Sonenshine, D. E. 1993. Biology of Ticks. Vol. 2. Oxford University Press, New York.

[28] Suzuki, D. and Grady, W. 2004. Tree: A Life Story. Vancouver: Greystone Books. p. 110.