REVIEW OF PUBLIC HEALTH ADVICE ABOUT TICKS

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To make decisions about how to deal with ticks, the public, clinicians and public health professionals require evidence-based, unambiguous and practical information. This article provides an introduction to ticks and a brief description of the review of NSW Health's public health advice about ticks.

BACKGROUND

Ticks are arthropods: that is, animals with an external skeleton and jointed legs. Within this phylum they are arachnids, in the subclass acari, closely related to mites. There are 2 main tick families: Ixodidae, or hard ticks, with over 700 species worldwide; and Argasidae, or soft ticks, with up to 185 species worldwide.[1]

In Australia there are approximately 70 species of ticks, most of which are hard ticks. The majority of these ticks are native, but some introduced species are widely distributed. In New South Wales, from a public health perspective, the most important is *Ixodes holocyclus*, a native species also known as 'paralysis tick'. Like all ticks, *I. holocyclus* is sensitive to desiccation (dehydration) and so a temperate climate with relatively high levels of humidity is the best for tick survival.[2] *I. holocyclus* is found from Queensland to Victoria, mainly in humid bushland areas on the eastern seaboard along a coastal band that, in parts, extends up to 70 km inland. Encounters between *I. holocyclus* and humans are relatively common, due to the fact that a large proportion of the human population lives within the coastal band, and urban development is increasingly encroaching into bushland.

Ticks are ectoparasites, which means they live and feed on the outside of their hosts. The main hosts for *I. holocyclus* are bandicoots, but the tick also attaches itself to other animals including humans. The life cycle of the tick includes 4 stages of development: egg, larva, nymph and adult. During their lifecycle, most species of hard ticks feed on the blood of 3 different hosts, 1 each for the larva, nymph and adult stages. Larvae and nymphs feed for several days and then drop off the host to the ground where they moult into the next stage. Adult females feed to obtain nutrients to develop eggs; after feeding for several days they drop off the host and lay thousands of eggs on the ground before dying. Adult male ticks feed on hosts and on engorging adult female ticks. *I. holocyclus* takes approximately 1 year to complete its lifecycle. Larvae are most common in the autumn months, nymphs are most common in winter, and adults are most common in spring, but tick stages can overlap across the seasons. Figure 1 includes a graphic representation of the life cycle of *I. holocyclus*.

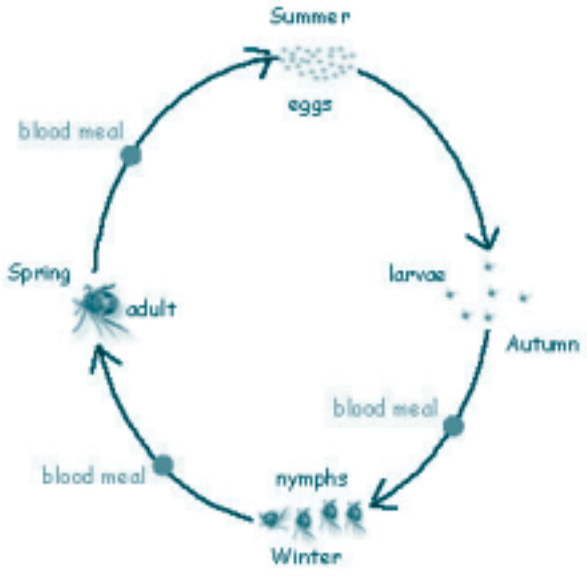
From the ground, ticks climb to grasses or low bushes and 'quest' for a passing host. Once on the host they move upward until they find a suitable place to attach. In humans this is often a place where they will not be easily found such as skin folds. Ticks use their conical lower lip (hypostome) to penetrate the skin of the host. They then secrete a mixture of substances, such as anticoagulants and prostaglandins, to inhibit haemostasis, augment local blood flow and suppress the inflammatory and immune response of the host, and thus secure both attachment to and meals from the host.[2] In addition, some ticks secrete a cement to further secure attachment. *I. holocyclus* does not secrete cement but penetrates the skin deeper than some of the other species of tick.

Clinical presentation and public health importance

In addition to being itchy and sometimes painful, the bites of *I. holocyclus* may be associated with other health problems such as allergic reactions, tick paralysis and the transmission of organisms that can cause infectious diseases. Further, scratching at the site of the bite can lead to secondary infection, and a foreign body granuloma

FIGURE 1

LIFE CYCLE OF *IXODES HOLOCYCLUS*



Note: The sizes of unfed ticks (larvae: pin-point size; nymphs: pin-head size; unfed adult: match-head size) may not be accurately represented in the picture.

Source: Dr Norbert Fischer, Crown Street Veterinary Hospital, Wollongong, New South Wales.

may develop when parts of the tick's mouth are left in the host after incomplete removal of the tick.[3]

Allergic reactions to tick bites

Allergic reactions to tick bites are caused by allergens contained in the saliva of *I. holocyclus*. These allergens, studied extensively by Gauci et al.,[4] are introduced into the host from the time of the tick's attachment. It has been reported that all biting stages of *I. holocyclus* can sensitise a host, which can later precipitate an allergic reaction.[2,5] Anecdotal evidence suggests that most allergic reactions follow bites by female adult ticks.

Allergic reactions range from mild local reactions to generalised and sometimes severe reactions including anaphylaxis.[5,6] Local reactions are the most common. They may last for weeks and, depending on their severity, may require medical treatment. Even though severe allergic reactions are rare, it is important to be aware that they may occur shortly after a tick bite.[7] Usually a history of worsening reactions to previous tick bites precedes a severe systemic reaction,[2] and adrenaline and resuscitation facilities may be needed to treat these systemic reactions.[2,5] Individuals who have experienced severe allergic reactions to tick bites should have access to injectable adrenaline at all times.[2]

Tick paralysis

Tick paralysis in humans is a rare but potentially fatal condition; young children are the most commonly affected.[8,9] Tick paralysis is caused by neurotoxins contained in the saliva of engorging female adult ticks. Symptoms start several days after attachment of the tick, when the tick reaches a rapid feeding phase accompanied by intense salivation, which coincides with high production of toxins.[8] Initial symptoms of tick paralysis include unsteady gait, weakness of limbs, and lethargy; an ascending, flaccid and symmetrical paralysis progresses over hours. In severe cases ventilatory failure may occur. Tick paralysis, particularly in a child, should be treated in intensive care where supportive management is usually sufficient. In severe cases the use of an antitoxin may be necessary,[10] but antitoxins should be used cautiously as they may cause allergic reactions.[11] Removal of the tick is an important step in the treatment of tick paralysis. However, an important characteristic of paralysis caused by *I. holocyclus* is that the condition may continue to deteriorate even after the tick has been removed.[3,8,10] Recovery is often slow.

Tick-borne infectious diseases

After a few days of attachment, a tick infected with a pathogen (whether a virus, bacteria or protozoa) may transmit the pathogen to the host with its saliva and cause an infectious disease.

Spotted fevers are the main tick-borne infectious disease in Australia. Even though they are not thought to be common diseases, the real incidence of these and other tick-borne infectious diseases in New South Wales is not known as the conditions are not notifiable.

I. holocyclus is the main vector for human transmission of *Rickettsia australis*, the bacterium that causes one of the spotted fevers (Queensland tick typhus). The geographical distribution of Queensland tick typhus is the same as that of *I. holocyclus*. Nonspecific symptoms develop between 1 and 11 days after the tick bite and include fever, chills, myalgia, arthralgia, headache and regional lymphadenopathy. In up to 70 per cent of cases, a characteristic eschar (dry scab) with a black necrotic centre and red areola is present at the site of the bite.[11] A generalised maculopapular rash (a rash that usually covers a large area, is red and has small confluent bumps) may appear a few days after the onset of the nonspecific symptoms. Clinical diagnosis is confirmed by serology. Queensland tick typhus can be treated with doxycycline, an antibiotic belonging to the class called tetracyclines. Serious illness is rare.[3] If untreated, the fever usually resolves in 1–2 weeks, but other symptoms may persist for several months.[3]

Flinders Island spotted fever has a similar presentation to Queensland tick typhus. It is caused by *Rickettsia honei* and the main vector is the tick *Ixodes cornuatus*. Most reported cases are from Flinders Island, mainland Tasmania and Victoria.[3]

Lyme disease is caused by the bacterium *Borrelia burgdorferi*, which is transmitted to humans by certain species of *Ixodes* ticks. Symptoms of Lyme disease appear within days, weeks or months of a tick bite and include early nonspecific symptoms such as fever, headache, arthralgia and myalgia, which may be accompanied by erythema migrans, a characteristic 'bull's-eye' rash around the site of the tick bite. The nervous, cardiac and musculoskeletal systems may be affected at later stages of Lyme disease. Cases of patients with symptoms resembling Lyme disease have been reported from eastern Australia since 1982,[12] but these cases have not been confirmed with serology.[3] Hudson et al. postulate that the cause of the disease in Australia is a spirochaete (a spirally-coiled rodlike bacterium) related to *B. burgdorferi*.[13] However, a study that examined over 12,000 ticks collected in coastal areas of New South Wales failed to detect *B. burgdorferi* or any other spirochaete.[14] *I. holocyclus*, the logical candidate vector of the pathogen in Australia, has been shown to be incapable of maintaining or transmitting *B. burgdorferi* to humans.[15] The existence of Lyme disease in Australia continues to be debated.

I. holocyclus is also a vector for *Coxiella burnetti*, the agent responsible for Q fever. However, this disease is mainly acquired through contact with infected farm and domestic animals.

Other infectious diseases such as tick-borne arboviral infections, babesiosis and ehrlichiosis are a burden in other parts of the world because of their effect on both human and animal health. The Australian Quarantine and Inspection Service ensures that the species of ticks that are vectors for these diseases are not introduced into Australia.

REVIEW OF PUBLIC HEALTH ADVICE ABOUT TICKS, IN PARTICULAR ABOUT *I. HOLOCYCLUS*

In 2002, in response to public concern about ticks, the NSW Department of Health published the brochure *Tick Alert*. A review of the brochure, which is mainly about *I. holocyclus*, was completed in March 2004. The review involved an initial revision of the existing brochure by the Northern Sydney Public Health Unit followed by consultation with relevant stakeholders. These included infectious disease physicians, emergency medicine clinicians, dermatologists, clinical toxicologists, immunologists, entomologists, toxicologists, consumers, veterinarians, health departments and other providers of information about ticks to the public such as the NSW Poisons Information Centre and St John Ambulance Australia.

There was general agreement that in addition to providing information about health problems that may follow a tick bite, one of the main messages of the brochure should be how to prevent tick bites—just as prevention advice is provided about other vectors of disease. To ground this advice, the brochure includes information about the ecology of ticks, in particular *I. holocyclus*, their lifecycle and habitat.

During the first round of consultation, many of the comments received were about methods of tick removal. Most stakeholders proposed 1 of 2 methods: mechanical removal of ticks or killing the tick in situ prior to removal. One of the difficulties faced at this point was that there is no clear evidence to support or refute either method for the removal of *I. holocyclus*. An evaluation of 5 methods commonly advocated for tick removal concluded that mechanical removal by grasping the tick's mouth-parts close to the skin and pulling it off should be used for all ticks unless research on a particular species suggested a different approach.[16] This method is recommended in many publications that refer to tick removal. However, proponents of the method of killing the tick in situ pointed out that certain characteristics of *I. holocyclus* (such as its small size and its method of attachment by deep penetration of the skin without deposit of cement) may require a different method of removal. These proponents refer to advice provided by Stone,[17] who postulated that the mechanical removal of *I. holocyclus* may induce anaphylaxis as a result of rapid dispersal of toxins and allergens away from the bite site. Stone has suggested that *I. holocyclus* should be killed in situ using an insect or tick repellent containing pyrethrins or synthetic pyrethroids.[17]

A meeting of stakeholders was held in February 2004. Some stakeholders provided comments in writing before the meeting and these were used to inform the discussion. Consensus was reached at the meeting to advise the public to remove ticks as soon as they are found, using fine forceps (not ordinary tweezers) or surgical scissors. There was agreement that there was not enough evidence to suggest that killing the tick in situ reduced an individual's exposure to allergens. In addition, participants discussed the danger of providing advice to the public that recommended killing attached ticks with repellents, as this advice may lead to the use of inappropriate products on the skin.

There are several products and methods commonly used to treat tick bites, including applying petroleum jelly, methylated spirits or nail polish, and burning the tick with a hot match. These methods were evaluated by Needham, who found that they failed to cause ticks to detach.[16] Anecdotal accounts suggest that sodium bicarbonate may be useful to calm the itchiness associated with tick bites, but there is no evidence to support this practice.

CONCLUSION

Even though the burden of disease attributable to tick-related illness is perceived to be small, the incidence of tick-related illnesses is unknown. Evidence is also lacking in relation to methods of tick removal. Studies to answer these questions would be useful.

The public health advice about ticks in New South Wales should be reviewed regularly, particularly if new evidence relevant to this advice becomes available.

The revised public health information brochure *Tick Alert* can be downloaded from the NSW Department of Health website at **www.health.nsw.gov.au**.

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A SURVEY OF BEDBUGS IN SHORT-STAY LODGES

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An increase in the number of anecdotal reports of bedbug infestations in short-stay lodge-type accommodation used by backpackers and other budget travellers in the City of Sydney prompted a pilot survey to determine the extent of the problem. The aim of the survey was obtain the perspective of the lodge managers on bedbug problems and how they handled them. This article describes the survey results and assesses the effectiveness of the methods of control reported.

BACKGROUND

Bedbugs have long been associated with humans and have been a significant problem for accommodation providers for centuries. The bug uses its piercing proboscis to feed on human blood at night and lays eggs in bedding and furniture. Bedbug bites can cause significant irritation, and some individuals are particularly sensitive. While posing a potential problem, bedbugs are not known to be vectors of disease.[1,2] Only the common bedbug *Cimex lectularius* has been found in Sydney to date, although the tropical bedbug *Cimex hemipterus* may be a recent import, given the number of travellers arriving from northern Australia and Asia, where it is endemic, and given that this species was recently recognised in Queensland.[3]

Infestations of bedbugs have traditionally been associated with poor sanitation, but the dramatic resurgence of bedbug activity in Australia and overseas may be attributed to a number of different causes.[4] The introduction of residual insecticides and improved standards of domestic hygiene have significantly reduced the bedbug problem but a number of recent studies indicate a reappearance of bedbugs overseas and in Australia.[5–8] Increasing complaints of bedbugs by short-stay guests, including reports to the City of Sydney's Environmental Health Unit, the South Eastern Sydney Public Health Unit, and local doctors, prompted us to conduct a survey of the situation in short-stay lodges in Sydney.

Short-stay guests are an important component of Australian tourism, contributing around 20 per cent of the total number of tourists. Following recent council amalgamations, the enlarged City of Sydney now has about 6,000 short-stay beds in around 65 lodges, some of which have been in continuous operation for more than 15 years. Guests stay an average of 3–4 days. Many of these guests have spent time in lodges throughout Europe, Asia and Australia, where they may have been exposed to bedbugs before arriving in Sydney, although there is no evidence of transmission of bedbugs from other countries to Australia or from other states to New South Wales.

SURVEY REVEALS EXTENT OF THE PROBLEM

All 52 short-stay lodges on the City of Sydney City register before the council amalgamation were asked to participate