Case Report

A brown dog tick *(Rhipicephalus sanguineus)* bite at sea

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Abstract

Medical Officers (MOs) and Medical Branch Ratings (MBRs) must maintain an awareness of the risk of vector-borne diseases among deployed personnel.

Personnel working in the maritime environment may not expect to be at risk of tick bites, as ticks typically occupy habitats with dense vegetation such as forests or scrub land. However, tick-borne pathogens can cause serious and sometimes fatal disease, and therefore the risk of tick bites and associated diseases should be recognised.

We present a case of a tick bite in a member of a ship's company eight days after leaving port. The tick was identified as a brown dog tick (*Rhipicephalus sanguineus*), a species known to thrive indoors. We describe several important tick-borne diseases which can be transmitted by *R. sanguineus* and explore best practice for tick removal and aftercare. Finally, we outline the appropriate management of suspected tick-borne disease in deployed personnel in the maritime environment.

Introduction

Ticks have a worldwide distribution and occupy a variety of habitats (1). Ticks belong to one of two main families: hard ticks (*Ixodidae*) and soft ticks (*Argasidae*). This article focuses on a member of the *Ixodidae* family, although it should be noted that similarities exist between the two groups (2). There are over 700 different species of hard tick, approximately twenty of which live by haematophagy on the blood of humans. Pathogens are often transmitted during feeding, many of which may lead to serious and potentially fatal disease. The type of pathogen transmitted varies with the species of tick (1).

Tick-borne diseases in the United States, Europe and Asia are increasing in incidence and hard ticks pose a significant public health issue as vectors of serious disease (3). Several measures have been proposed to reduce the risk of tick-borne disease in humans, including avoiding high-risk areas, as identified by a high population density of ticks. Avoidance of some species may be easier if they are known to occupy a well-defined habitat (e.g. the Western black-legged tick *Ixodes pacificus* of North America is restricted to dense woodland). However, other species occupy a peri-domestic environment or, as with *R. sanguineus,* an *endophilic* (indoor) environment (4). Due to this predilection, *R. sanguineus* represents a risk to personnel on board sea-going vessels. Whilst there are no published data on the incidence of ticks on maritime vessels, this case demonstrates that tick bites may occur at sea among Royal Navy personnel.

In addition, tick bites are often painless and may go unnoticed by patients, or be mistaken for warts, particularly if the tick is fully engorged with blood (1). Patients may therefore present with tick-borne diseases without a known history of tick bite. MOs and MBRs must be aware of the management of tick bites and consider tick-borne diseases in patients presenting with systemic illnesses with or without a history of a bite.

Case report

A 20-year-old Air Engineer Technician (AET) presented to the sickbay of Royal Fleet Auxiliary FORT AUSTIN (FTAU) 30 minutes after noticing a tick on his left shin. At the time, FTAU was operating in the Arabian Gulf on Op KIPION. The preceding port of call was Bahrain and FTAU had been at sea for eight days.

A parasite was located on the anterior aspect of the patient's left shin and was identified as a tick. Following inspection, no other parasites were found on his body. The patient was otherwise well and denied fever or rash. Observations were all within the normal parameters and on systemic examination no abnormalities were noted.

The tick was removed using blunt forceps and the site of attachment was cleaned with topical chlorhexidine gluconate/ isopropyl alcohol (2%/70%). The tick was identified as an adult brown dog tick (*R. sanguineus*, Figure 1).

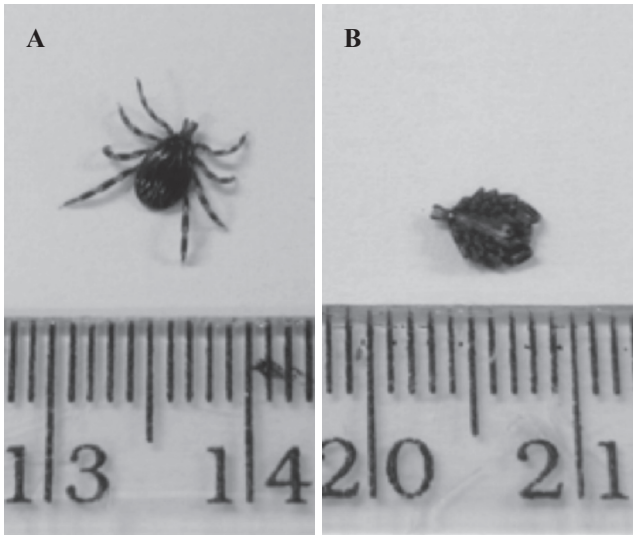

Fig 1. Rhipicephalus sanguineus.
A. Dorsal view showing dorsal shield, legs and mouth-parts (marker = cm).
B. Ventral view showing genital (solid arrow) and anal (dashed arrow) orifices (marker = cm).

The patient was discharged with the advice to be alert to features of systemic illness, such as fever, rash or feeling generally unwell. He was advised to seek medical attention if any of these features occurred within the next 30 days. The patient was fit and well for the next two weeks but was then lost to follow-up following disembarkation.

Rhipicephalus sanguineus

The brown dog tick *R. sanguineus* has a worldwide distribution. While dogs are the primary host in each of its life stages, it will feed on a wide variety of mammals including domestic animals and humans (4). *R. sanguineus* is unusual among ticks as it can complete its entire life cycle indoors and, while more commonly found in warmer climates, it can also establish populations in cooler regions. Infestations in houses can occur rapidly. Typically, a few ticks are introduced into the house or kennel, often on a dog that has been away. The early stages of the infestation are often unnoticed and the first indication is when ticks are seen crawling over walls and furniture. *R. sanguineus* is easily identified. It is small, red-brown in colour and lacks ornamentation. It has an elongated body and hexagonal basis capituli (the plate at the base of the head). *Ixodid* ticks require three blood meals to complete development and *R. sanguineus* is a three-host tick in that it leaves the host to develop and moult between the larval, nymphal and adult stages (either on the same or different hosts).

An adult female tick will feed on the host for one week then detach and find a suitable location for egg development, such as cracks and crevices in houses. The female will start laying eggs as soon as four days after leaving the host and for up to fifteen days. The number of eggs laid by a fully blood-fed female brown dog tick is dependent on the size of the tick and the amount of blood ingested, but can number up to 5000 eggs. The eggs hatch 19-60 days later and the larvae then search for a host. Larvae feed for between three and nine days and develop into nymphs in about 6-23 days. A nymph then feeds for four to nine days and after 12-29 days develops into an adult. The overall life cycle can be completed in two months but will take longer if there are few hosts available, or in cold temperatures. Ticks are remarkably long-lived and adults can survive up to eighteen months without feeding (4).

Pathogen	Associated Disease	Clinical Features of Infection
Coxiella burnettii	Q fever	**Acute**: Primary infection often asymptomatic. May present with features of Q fever pneumonia or hepatitis (fever, headaches, and myalgia). **Chronic**: May lead to endocarditis and vascular disease.
Rickettsia coronii	Mediterranean spotted fever	Fever, widespread rash and "tache noire" (typical eschar at the site of the tick bite).
Rickettsia rickettsii	Rocky Mountain spotted fever	Fever, severe frontal headache, restlessness / insomnia, severe myalgia, relative bradycardia, acute deafness.

Table 1. Pathogens transmitted by R. sanguineus, with their associated diseases (4, 12,16,17).

Pathogens causing disease in humans that may be transmitted by *R. sanguineus* include *Coxiella burnettii*, *Rickettsia coronii* and *Rickettsia rickettsi* (Table 1).

Clinical management of tick bites

The clinical management of tick bites can be divided into prevention, removal and follow-up.

Prevention

Several public health measures have been recommended to prevent tick bites (3). Suggestions include: advice to travellers to avoid areas deemed to be high-risk; wearing clothing that covers exposed skin on the limbs; and applying N,N-Diethyl-meta-toluamide (DEET) or permethrin-based products prior to expected exposure to ticks. There are insufficient risk data on ticks to advise such measures among personnel working at sea. However, the application of DEET and use of long-sleeved clothing are important aspects of preventative measures against mosquito-borne diseases (5). These are advised when the ship is in certain locations, such as when alongside or anchored within two kilometres of shore of a country known to be at high-risk for malaria.

Removal

In this case, the tick was removed with blunt forceps. Patients may consider removing ticks before, or without, seeking medical attention. There are a variety of techniques to remove ticks including the application of substances such as petroleum jelly, fingernail polish or alcohol, or burning the parasite with a naked flame. All have been shown to fail routinely in inducing tick detachment and are not advised (6). The goals of tick removal are threefold: to remove the offending parasite; to minimise the risk of vector-borne disease; and to minimise the risk of local secondary infection.

These can be achieved in a Role One setting using equipment readily available in a ship's sickbay. In order to minimise the risk of vector-borne disease, ticks should be removed as soon as practicable. It has been shown that the risk of transmission of several pathogens increases with the duration of tick attachment (7-9). If a tick is placed under stress, it may regurgitate its stomach contents into the host, potentially increasing the risk of introducing pathogens (10). Methods such as spreading petroleum jelly or nail varnish onto ticks are intended to 'starve' them of oxygen, inducing detachment. However, the respiratory rate of an unfed adult tick is approximately fifteen breaths per hour (6). Therefore, these measures are not only ineffective, but are likely to stress the parasite, increasing the chance of inoculation with tick-borne pathogens and subsequent infection. Local bacterial infection is likely if attachment points of the tick remain embedded in the patient's skin. In addition, local irritation caused by retained debris is likely to lead to pruritus, and the introduction of other pathogens (6). Complete tick removal followed by cleaning is required to minimise the risk of local infection.

The recommended removal technique is as follows (6,10):

1. The clinician is to don appropriate Personal Protective Equipment (apron and gloves).
2. Using blunt forceps (medium-tipped, angled if available), grasp the tick as close to the point of attachment at possible (flush with the skin).
3. Apply continuous firm traction perpendicular to the skin (do not twist).
4. If any parts of the tick remain, they should also be removed.
5. Once fully removed, clean the area of attachment with appropriate antiseptic (e.g. chlorhexidine).

Follow-up

Following removal, the patient must be informed of the risk of tick-borne diseases and advised to monitor for their features for up to 30 days, although it should be appreciated that chronic features of some infections take longer to develop (11,12). Patients should specifically observe for skin changes at and around the site of the tick bite (e.g. erythema migrans, the pathognomonic rash of Lyme Disease), but should also be aware that tick-borne diseases can manifest with non-specific and systemic symptoms (13). Patients should be advised to report a previous tick bite when seeking medical attention in the future.

Antibiotic prophylaxis to prevent Lyme Disease has been recommended in very specific circumstances (e.g. *I. scapularis* attachment over 48 hours). However, there are conflicting views on the efficacy of this treatment, so at present it is not routinely advised (14,15). If the patient is immunosuppressed, pregnant, or has been bitten in an area endemic for Lyme Disease, prophylaxis may be indicated and specialist advice should be sought (10). Pathogens that can cause disease in humans that are, or may be, transmitted by *R. sanguineus* are outlined in Table 1.

Regardless of the species of tick and pathogen transmitted, infection is most likely to present with features of generalised systemic illness including fever, rash and malaise. Suspected tick-borne diseases represent a medical emergency at sea; casualty evacuation (CASEVAC) to a Role Two facility with intensive care capability or to Role Three specialist care should be considered (1).

Occupational considerations

Uncomplicated tick removal requires monitoring for up to 30 days. Clinical judgement is required to deem whether the tick bite is high-risk for transmission of tick-borne disease. Factors guiding a risk assessment include duration of tick attachment, prevalence of tick-borne diseases in the area and, if identifiable, the species of tick with consideration of pathogens transmissible by that species. If a high-risk

tick bite has occurred, the clinician may wish to prevent personnel deploying to areas remote from Role One healthcare during the 30-day period.

Tick-borne diseases warrant CASEVAC for in-patient management in at least a Role Two facility, followed by AEROMED for care in a UK facility as the clinical and operational situation dictates. Return to duty and subsequent occupational restrictions should be determined by any residual functional deficits determined by specialist assessment. These may involve neurological, cardiovascular, respiratory, gastrointestinal or musculoskeletal deficits. Diagnosis can be profoundly difficult in view of the vague and varied presentations of tick-borne diseases. Serology testing exists with Polymerase Chain Reaction (PCR) or enzyme assays for the most common tick-borne diseases, but must be requested using a targeted approach as they can be costly and time-consuming (18).

Conclusion

Although it is well recognised that tick bites and tick-borne diseases pose a risk to personnel deploying to areas of thick vegetation in the land environment, this case demonstrates that a risk exists for those serving at sea.

R. sangineus is a species of tick with worldwide prevalence that thrives in indoor environments and therefore can survive on-board seagoing vessels whilst seeking a suitable host. It is capable of transmitting several serious diseases, including Q fever, Rocky Mountain spotted fever and Mediterranean spotted fever.

Tick-borne diseases can present in a non-specific manner several weeks or months after a bite. Patients may be unaware that they have been bitten or may not associate their symptoms with a bite and therefore not be forthcoming with a history of tick bite. If the patient presents with an attached tick, prompt removal using the correct technique can minimise the risk of pathogen transmission.

MOs and MBRs serving at sea need to maintain an awareness of tick bites, correct removal techniques and the features of tick-borne diseases. Tick-borne diseases should be considered in patients presenting with non-specific symptoms with or without a history of tick bites. Occurrence of a tick-borne disease at sea constitutes a medical emergency and early CASEVAC to a Role Two or Three medical facility should be considered.

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