Scrub typhus: a recent outbreak among military personnel in North Queensland

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Abstract

- Scrub typhus is a mite-borne disease predominant in dry scrub areas of North Queensland and the Northern Territory.
- The incubation period is about 12 days. The disease involves fever and headache, a macular rash, and (in most cases) an eschar at the bite location.
- In March and April 2005, 32 soldiers who had been in the Cowley Beach Training Area reported sick with fever, headache and joint pain.
- Treatment was initiated on the presumption of leptospirosis. Results of laboratory investigations showed 20 had scrub typhus, and two had Queensland tick typhus. In practice, the treatment is the same as for the presumptive diagnosis of leptospirosis (doxycycline 100 mg twice daily by mouth for 5 days).
- Ten soldiers reported not taking prophylactic doxycycline and not treating their uniforms and mosquito nets with permethrin.
- Some supervision by junior officers and NCOs is necessary to ensure soldiers take appropriate precautions for all diseases where prophylaxis is recommended.

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ALTHOUGH IT HAS BEEN CLAIMED that "the jungle is neutral",[1] the Australian bush is a potentially hostile environment and visitors can contract a range of serious illnesses. In March and April 2005, 22 soldiers contracted typhus while training in a coastal area of North Queensland. Initially, it was thought that they were suffering from leptospirosis, which is endemic in the area, but serological testing confirmed 20 cases of scrub typhus and two of Queensland tick typhus. Following treatment, all made a full recovery.

Typhus

Typhus is a disease caused by one of the family of Rickettsia microorganisms, which are transmitted to humans via the bites of parasites such as ticks and mites. There are five different entities: scrub typhus (carried by mites), Queensland tick typhus, murine typhus (flea-borne), louse-borne typhus, and relapsing louse-borne typhus (Brill–Zinsser disease). Another group of rickettsial diseases includes Rocky Mountain spotted fever, rickettsial pox, Q fever (*Coxiella burnetii*) and Boutonneuse fever. With the exception of Q fever, which is transmitted by airborne droplets, all are transmitted to humans by arthropods.

Scrub typhus is caused by *Orientia tsutsugamushi*, which is transmitted to humans by the bite of a "chigger", the larval form of the mite *Leptotrombidium deliense*. This is a parasite found on small rodents. It is found predominantly in areas of dry scrub or cleared land in North Queensland and the Northern Territory, and less commonly in rainforest.[2] It is also prevalent in Malaya and northern Thailand. It has never been reported further south than Sarina (Mackay), which is of particular military importance as the Shoalwater Bay Training Area — one of Queensland's most important areas for military training — is not affected.[3]

Queensland tick typhus was first described in soldiers training on the Atherton Tablelands during World War II.[4] The organism was appropriately named *Rickettsia australis*. As the ticks that transmit the disease are parasites of a variety of small mammals, it has been widely reported on the east coast of Australia, from Darnley Island in the Torres Strait to Wilson's Promontory in Victoria.[5]

Signs and symptoms

The incubation period for scrub typhus and Queensland tick typhus is about 12 days. Fever and headache is accompanied by a rash (Box 1), which is macular in the case of scrub typhus, and vesicular in tick typhus. In 60% of cases of scrub typhus, an ulcer (called an eschar; Box 2) forms at the place of biting. This may also be a feature of Queensland tick typhus, but not of any of the other varieties of typhus.[6] Local eschars

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1 The characteristic rash associated with scrub typhus

2 An eschar forms in about 60% of scrub typhus cases

occur less commonly in patients with rickettsial pox, and, only occasionally with the spotted fevers.

Untreated, scrub typhus varies from a mild febrile illness, from which the patient recovers in 6–8 weeks, to the severe form in which coma supervenes, and death follows in 12–16 days. In comparison, Queensland tick typhus is a relatively mild illness, although fatalities have been reported.[7]

All types of typhus have a tendency to relapse, and treatment may need to be repeated or prolonged.

Historical perspective

Rickettsial fevers have afflicted armies since the Middle Ages. Epidemic typhus fever (transmitted by lice) contributed significantly to the loss of life during Napoleon's retreat from Moscow in 1812. In World War I, a new louse-borne rickettsial disease caused by *Bartonella quintana* appeared on the Western Front. This was first called "pyrexia of unknown origin",[8] and subsequently named "trench fever".[9] By the end of the war, 800 000 Allied soldiers had been infected. Trench fever was considered the most prevalent disease among Allied troops serving in the trenches during World War I.

By 1935, widespread application of the Weil–Felix test had shown that the "North Queensland coastal fever" had the same agglutination profile as another rickettsial disease which occurred in South-East Asia, Japan, and parts of the south-west Pacific.[10] This disease was transmitted by mites, but was called (rather inappropriately) "tsutsugamushi disease" (Japanese: *tsutsuga* illness, *mushi* tick).[11] The more accurate nomenclature "scrub typhus" gradually supplanted previous names, and in 1995 the name of the genus was changed from *Rickettsia* to *Orientia*.[12]

During World War II, there was no specific treatment for scrub typhus, and it proved a considerable health threat both in the North Queensland training areas and in the Pacific theatre. Southcott reported outbreaks among troops in 1943 and 1944 in North Queensland, around Cairns and the hinterland.[3] In the course of operations in the south-west Pacific, Walker reported an overall mortality from scrub typhus of 9% (range, 6%–23%), in addition to the burden of illness and convalescence from the disease.[13] In New Guinea, as in northern Australia, the worst depredations of the disease were in areas of scrub, rather than in rainforest. Regimental histories include the names of medics who died from the disease along with their patients. A total of 2839 cases of scrub typhus were reported in the Pacific theatre between 1942 and 1945, and there were 257 deaths.[14]

Scrub typhus is found in dry scrub areas of Queensland and the Northern Territory. It has not been reported south of Sarina.

After the war, the incidence of scrub typhus in North Queensland declined. This was perhaps due to the widespread agricultural use of the insecticide dichloro-diphenyl-trichloroethane (DDT). The last deaths from scrub typhus in North Queensland were reported in 1952, one from Mission Beach (near Tully) and the other from Cape Tribulation (near Daintree).[4] Thereafter, no reports of cases in North Queensland were published until 1997, although sporadic cases were recorded in other parts of Australia.[15,16] Furthermore, the availability of the tetracyclines made effective treatment possible.

Queensland tick typhus was first identified by Lieutenant Colonel Rod Andrew, the Officer Commanding the Medical Division of 2/2 Australian General Hospital, which was stationed at Rocky Creek on the Atherton Tablelands.[4] Between March 1944 and February 1945, he diagnosed 12 cases in this location. During the same period, 22 cases of scrub typhus were treated, and 13 cases of murine typhus, which is transmitted by fleas. These latter cases were limited to soldiers who had travelled to North Queensland from the south by train, and had probably shared army blankets.[17]

Two faces of Cowley Beach. The foreshore is used for training in amphibious operations. The scrub is home to cassowaries, wild pigs, crocodiles, and various disease vectors.

Cowley Beach Training Area

Scrub typhus was first recognised in soldiers using the Cowley Beach Training Area in 1996. A further outbreak occurred in March 1997. The presentation of the condition on these occasions was classical, with fever, headache, a rash, and an eschar. All patients responded to treatment with tetracycline.

Following these occurrences, vigorous countermeasures were put in place for all North Queensland training areas: all soldiers entering the areas were required to impregnate their uniforms with Peregin 500 (permethrin), and mite repellent (NSN 6840-66-023-2940) was issued for application to the skin. This contained 99% dibutyl phthalate, which proved to be a skin irritant, and was later replaced with insect repellent lotion (NSN 6840-66-106-0247) containing diethyl toluamide.

Subsequently, when scrub typhus was diagnosed in a soldier from the Cowley Beach Training Area who had these measures in place, chemoprophylaxis with doxycycline was added to the physical precautions for this area. This method had been successfully tested by the United States Navy in Taiwan,[18] and following its introduction at the Cowley Beach Training Area, no cases were reported until the outbreak in 2005.

The recent outbreak

Presentation

Over a 10-day period in March and April 2005, 32 soldiers from Lavarack Barracks in Townsville reported sick with a fever, headache, and joint pains. Although they were not all from the same unit, all had recently returned from training in the Cowley Beach Training Area, which had involved fire and movement through the bush. The severity of the illness varied considerably: some patients did not require admission to hospital; others were extremely ill. Eschars were noted in only three patients. If scrub typhus had been the provisional diagnosis, a more intrusive examination might have revealed more eschars, but multiple insect bites were common in this group of patients.

Investigations

Serum was taken from all of the patients for scrub typhus immunofluorescence assay, IgM titre, DNA polymerase chain reaction (PCR), and spotted fever enzyme immunoassay, in addition to screening for leptospirosis, dengue, and Ross River fever (Box 3). Two patients who tested positive for DNA were negative for all other tests. It was assumed that these were false-positive results. It was of note that not all patients with positive immunofluorescence titres for scrub typhus were positive for IgM.

Immunofluorescence appears to be the most consistently reliable test for the disease.

Treatment

As the test results were not immediately available, treatment was initiated based on clinical assessment. In this instance, the assumption that the cause was leptospirosis (which is

3 Results of investigations for 32 patients who reported sick with a fever, headache, and joint pains in March and April 2005

All investigations negative: 8

Scrub typhus

Rising immunofluorescence titres: 20

IgM positive: 13

DNA positive: 5

Other diseases

Queensland tick typhus immunoassay positive: 2

Leptospirosis positive: 0

Note: no diagnosis was made for the 8 soldiers whose investigations were all negative.
Two soldiers had positive DNA results for scrub typhus, but negative immunofluorescence results. These were assumed to be false positives.

common in the nearby Tully region) proved incorrect, but in practice the treatment did not differ.

Doxycycline 100 mg was given twice daily by mouth for 5 days. Symptoms resolved generally within 48 hours, and there were no relapses.

Prophylaxis noncompliance

In the course of history taking, 10 of the 22 soldiers infected with scrub typhus or tick typhus admitted to having failed to take prophylactic doxycycline and to having omitted to treat their uniforms and mosquito nets with permethrin. Noncompliance may have been under-reported because of fear of disciplinary action. However, any disciplinary action would seem to be unfair, as there must have been other members who did not take any precautions but were not infected or had only a subclinical infection.

Where there was a genuine reason for avoiding doxycycline (such as light sensitivity, or possible pregnancy), an alternative antibiotic (roxithromycin, azithromycin) could have been offered, but there is no record of any such request. In most cases, the failure to take medication was due to the loss of collective memory of the possible consequences, given that the last reported cases among Townsville military personnel occurred in 1997.

There is an important lesson to be learned here not just in respect of scrub typhus, but for all diseases for which chemoprophylaxis is necessary. Some degree of supervision by junior officers and NCOs is mandatory.

Conclusions

A variety of zoonoses represent health threats to soldiers training in tropical Australia. Experience in North Queensland shows that careful precautions, including chemoprophylaxis, provide adequate protection against scrub typhus in areas that have been recognised as hot spots for the disease (north of Sarina). However, dose omission spells disaster.

Chemoprophylaxis against Queensland tick typhus is not currently indicated, but the liberal use of repellents and insecticides should be a requirement in all training areas on the east coast. In addition, careful examination of body crevices for ticks may prevent a very unpleasant and potentially lethal infection.

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Competing interests

None identified.

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