Tropical Rat Mite Dermatitis: Case Report and Review

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Six medical students inhabiting a centuries-old, rat-infested house in Lübeck, in northern Germany, were suffering from itching papules and seropapules. Prior to these patients' visit to our institute, their conditions had been diagnosed as pediculosis, scabies, or pulicosis and treated unsuccessfully with the antiparasitic agent lindane (0.3%). The final diagnosis, tropical rat mite dermatitis, was based on the identification of the arthropod *Ornithonyssus bacoti,* which has an unsegmented body with eight legs. No treatment was recommended, and the dermatitis disappeared within 2 weeks. Measures taken to prevent reinfestation included extermination of the rats and treatment of the rooms of the house with the acaricide benzyl benzoate. Because the mite *O. bacoti* spends a relatively short time on a host and penetrates the skin for feeding only, the application of an antiparasitic agent is not necessary. If indicated, treatment should be symptomatic.

The tropical rat mite is found in various parts of the world, but its presence appears to be locally restricted. In most cases, the mite is recognized only when it attacks humans. The unspecific symptoms of the dermatitis caused by attacks of the mite might be attributed to more well-known parasitic arthropods or even to nonparasitic causes, with potentially unfavorable effects on therapy.

Case Report

Six medical students sharing a house in the historic center of the seaport of Lübeck, in northern Germany, had itching papules developing in the daytime for several weeks. In prior medical consultations, treatment with lindane (0.3%) and benzyl benzoate (25%) emulsion (HERMAL; Reinbek, Germany) was recommended because the papules were considered to be due to pediculosis, scabies, or pulicosis. After several courses of unsuccessful treatment, the students rejected further application of the antiparasitic agent.

See article by Bonomo et al. and editorial by Mathisen on a related topic in the September issue on pages 645–6 and 646–8, respectively.

Physical examination of the students revealed pale, red papules and seropapules, located individually or in groups predominantly on the legs and arms but also in the area of the waist and laterally on the trunk. Some papules were as large as peas, and some were excoriated because of scratching in response to itching (figure 1). Primary lesions that had not been scratched had no central punctum. On histologic examination, perivascular infiltrates with eosinophilic granulocytes, confined to the upper corium, were observed.

No domestic animals were kept in the house, but uninvited commensal rodents—rats—were heard during the night. During a visit to the location of the centuries-old house, extensive work on the sewage disposal system in the street was noted.

Fortunately, specimens of parasites the patients had collected from their bodies were available. First observations through a light microscope allowed identification of a mite (Acari), a small arthropod (<1 mm) with an unsegmented body (the idiosoma) carrying four pairs of legs and a tiny gnathosoma with its mouthparts (figure 2A).

Identification of the species required review of pertinent literature [1] and preparation (protein denaturation by guanidine-HCl solution) of the mite for further microscopic examination. This examination revealed female adults of the species *Ornithonyssus bacoti* (first described by Hirst 1913; family Dermanyssidae, order Mesostigmata). Some of the anatomic features characteristic of this mite are shown in figures 2A and 2B. Careful consideration of the exact position, size, and morphology of the indicated structures and even of the hairs (setae) is essential for identification of the species.

A professional exterminator was contracted. In the days after the rat extermination with poisoned bait began, the dermatitis became so annoying that all inhabitants moved out of the house temporarily. In the meantime, all rooms of the building were repeatedly sprayed with a solution of 3% benzyl benzoate and 1% tannic acid (INNOV-ALL Pharma, Düsseldorf, Germany); they were subsequently renovated. After the students returned, no more mites or cases of dermatitis were observed.

No drug treatment was recommended, and the dermatitis disappeared within 2 weeks for five patients; the lesions on one female patient developed into maculae within a month.

Discussion

Mite attacks on humans attributable to rat mites were first reported from Australia in 1913. In the same year, mites were

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Figure 1. Excoriated papules on the shins of a female patient with tropical rat mite dermatitis.

collected in Egypt and described as a new species, *Liponyssus bacoti,* or tropical rat mite. *Bdellonyssus bacoti* is another important synonym. This mite was identified in 1923 as a cause of human dermatitis in the United States. In Europe, the tropical rat mite was first detected in the German seaport of Hamburg in 1931, a site indicating the mite was carried across the oceans along with infested ship rats, probably in the times of sailing vessels.

In recent decades, *O. bacoti* has been reported from all continents except the arctic and antarctic regions as a parasite of wild, commensal, and laboratory rodents or of humans [2–7]. *O. bacoti* was also reported to exist among other mites in samples of house dust in Egypt [8].

The life-cycle of *O. bacoti* is presented in table 1. The velocity of development and the degree of activity of the various stages depend on the ambient temperature and the availability of a host. The life-cycle can be completed within 10 days at a temperature of 25°C. Parthenogenesis is facultative, and unfertilized eggs have been observed to result in the development of males [10].

The larvae of the tropical rat mite were observed to move slowly, making it rather improbable that they would reach a host, starting from the place of oviposition. Thus, protonymphs seem to be the first host-infesting stage. However, Fishman has observed a larva attach itself to the skin of a host and molt there into a blood-feeding protonymph [7].

Despite long periods living on different cotton rat hosts, the meals of starving male mites were tiny in comparison with the quantities of blood drawn by starving female mites [10]. After a blood-meal, the female mite drops off its host. Two to 5 days of digestion and successive maturation of eggs are followed by 2–3 days of oviposition of one to 12 eggs [10]. The average life span of the females is 6.5 months, whereas the life span of the males ranges between 1.5 and 2.5 months [9].

Detailed information on the physiology of the feeding process of *O. bacoti* was not obtainable. The two terminal cheliceral segments of an attacking mite cut through the skin to reach a blood vessel. The proximal cheliceral segments form a tubular functional unit for sucking blood from the vessel tapped. From our micrographs, we estimate the inner diameter of this retractable pipe to be comparable with the inner diameter of a blood capillary (6 μm).

Although *Rattus norvegicus* and *Rattus rattus* are known to be the preferred hosts, infestation of 10 other rodent species has been reported. The low host specificity might be the reason why veterinary technicians were infested while handling laboratory mice [3]. Although reports of infestation of several rodent species caged for laboratory purposes (such as rats, mice, gerbils, and guinea pigs) have been published, there have been no reports of mite infestation of humans via these rodents when the animals were kept as pets in households. Young children sitting or lying on the floor or ground while playing and babies asleep during the daytime are hosts easily accessible to the mite. Within families, children have been reported to be the only or most heavily mite-infested patients [5, 6].

The tropical rat mite can infest patients of all age groups, and dermatitis may manifest itself on any part of the human body. The skin lesions can be more numerous on the parts of the body easy to reach by the mite or where parts of the clothing in tight contact with the skin have formed an obstacle for the mites. In one female patient, the condition was first restricted to the pubic region and initially diagnosed and treated as an infestation with *Phthirus pubis* [6]. An infestation including the scalp has been reported only once [2].

The single or grouped bites of *O. bacoti* may manifest themselves with mild pain, followed by slight, reddish swellings that can become erythematous papules of up to 4 mm [2] or even 10 mm in diameter [3]. The papules may be excoriated after scratching because of pruritus. Vesicles, nodules, or an urticarial component have been seen rarely [3, 5]. In addition to possible psychological effects, prolonged infestation may have severe physical consequences; for instance, chronic infestation for several months in an initially 3-week-old baby resulted in retarded growth [5].

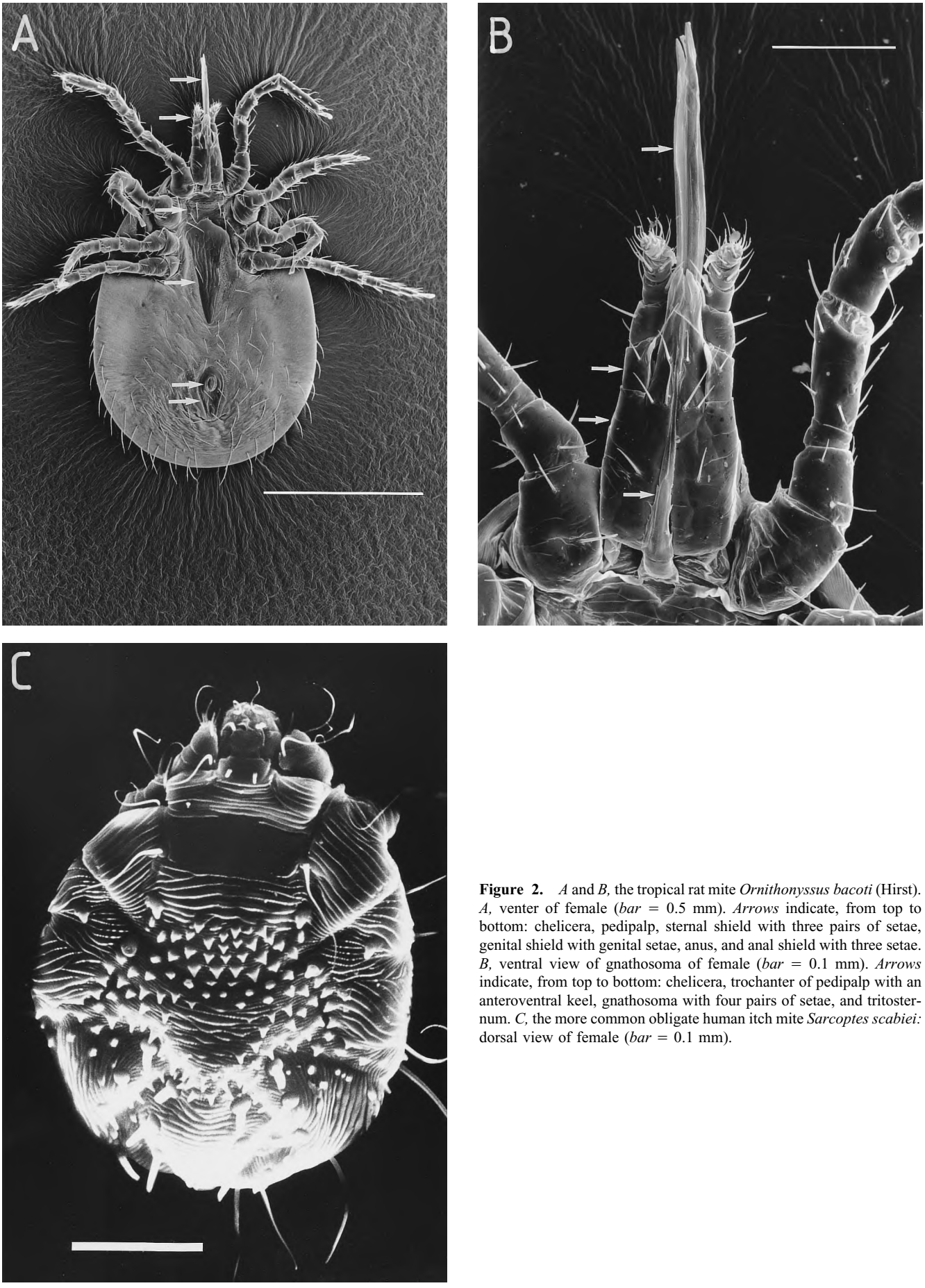

Figure 2. *A* and *B,* the tropical rat mite *Ornithonyssus bacoti* (Hirst). *A,* venter of female (*bar* = 0.5 mm). *Arrows* indicate, from top to bottom: chelicera, pedipalp, sternal shield with three pairs of setae, genital shield with genital setae, anus, and anal shield with three setae. *B,* ventral view of gnathosoma of female (*bar* = 0.1 mm). *Arrows* indicate, from top to bottom: chelicera, trochanter of pedipalp with an anteroventral keel, gnathosoma with four pairs of setae, and tritosternum. *C,* the more common obligate human itch mite *Sarcoptes scabiei:* dorsal view of female (*bar* = 0.1 mm).

Table 1. Life-cycle of *Ornithonyssus bacoti*.

Stage	Size (mm)	No. of legs	Feeding	Development (no. of h) at 20°C–25°C
Egg	0.35 × 0.22	0	No	28–54
Larva	≥Egg	6	No	30–40
Protonymph	F: 0.7 × 0.34, M: 0.5 × 0.27	8	F: twice, M: once*	48–52
Deutonymph	F: 0.7 × 0.34, M: 0.5 × 0.27	8	No	24
Adult	F: 0.7–1.5, M: 0.4–0.5	8	F > M	120 to first egg

NOTE. F = female; M = male.
* According to [9], frequency of feeding is related to the sex.

The diagnosis of rat mite dermatitis requires identification of the parasite, which is more likely to be found in the environment of its host than on the host itself. Microscopic examination of skin scrapings from pruritic papular eruptions on the backs of hands and the neck region has been reported to reveal tropical rat mites [4]. However, we doubt skin scrapings are useful for collection of *O. bacoti.*

Symptomatic relief has been achieved by treatment with antihistaminic drugs [2] or glucocorticoids [7]. All these medications were used to prevent further scratching and unrest caused by pruritus. Treatment with lindane was reported by some authors [3, 6, 7], and topical application of a 25% benzyl benzoate emulsion has been reported once [4]. Lindane and benzyl benzoate are usually recommended for the treatment of scabies and pediculosis pubis. In light of the adverse effects of lindane [11] and benzyl benzoate, these drugs should be used for well-diagnosed cases only, and never empirically. A simple bath will immediately remove specimens of *O. bacoti* from humans and domestic pets.

To prevent reinfestation, extermination of the rats and, if possible, removal of their nests are essential. Treatment of the environment with an acaricide such as benzyl benzoate is necessary given that the tropical rat mite is able to survive extended periods of starvation and to run long distances. Chemicals mainly known as insecticides, such as malathion [4], methylcarbamate [3], and lindane [7], have been reported to be effective. Fluoridated silica aerogel dust blown into spaces behind walls and under floors has also been used to control the tropical rat mite [12].

Characteristics of tropical rat mite dermatitis and other parasitoses that might be confused with the condition are presented in table 2. Figure 2C shows the more common obligate human itch mite (*Sarcoptes scabiei*) for comparison.

The tropical rat mite was claimed in 1931 to have transmitted endemic (murine) typhus to humans [13]. Until now, no further cases of transmission of disease to humans have been reported. However, several infectious diseases, including murine typhus, rickettsial pox [14], Q fever [15], tularemia [16], plague [17], eastern equine encephalitis [18], epidemic hemorrhagic fever, and coxsackievirus [19] and Langat virus (tick-borne encepha-

Table 2. Characteristics of parasitoses that might be confused with dermatitis due to the tropical rat mite *Ornithonyssus bacoti*.

Parasite, length (mm) of female	Main host	Infestation	Typical anatomic location	Specificity of skin lesion or reaction	Antiparasitic measure
Dermanyssus gallinae, <1.5	Birds	Temporary, at night; nidicole (parasite living in or near nest of its host)	None	None	Environmental: benzyl benzoate, lindane
Ornithonyssus bacoti, <1.5	*Rattus* species	Temporary, in daytime; nidicole	None	None	Environmental: benzyl benzoate, lindane
Sarcoptes scabiei, <0.4	Humans, varieties found on domestic animals	Permanent, in epidermis	Digital interspace, armpit, genitals, navel region	Burrows	Benzyl benzoate, lindane
Pediculus humanus corporis, <4.0	Humans	Temporary; permanent in clothes	None	None	Disinfection of clothes with pyrethrum extract
Pediculus humanus capitis, <2.7	Humans	Permanent, in hair	Scalp	None	Pyrethrum extract, lindane
Xenopsylla cheopis, <2	*Rattus* species	Temporary	Clothed parts of body	Multiple, grouped; with central punctum	Insecticides for environment
Ctenocephalides canis, <3.5	Dogs, cats	. . .			
Pulex irritans, <3	Humans	. . .			

litis virus complex) infections [20], have been transmitted by *O. bacoti* under experimental conditions. Finally, these mites have been reported to be the intermediate host of the filarial nematode *Litomosoides carinii* of rodents [10].

In contrast to the experimental potential for disease transmission and to the information available in the literature, the epidemiological importance of the temporary ectoparasite *O. bacoti* as a vector of pathogens is very rarely documented in human-case reports, possibly because of the difficulty of identifying the mite. We hope the information given here will draw attention to this subject.

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