Research Note

Dermatosis caused by the bite of trombiculid mite larvae, *Leptotrombidium intermedium* (Nagayo, Mitamura et Tamiya, 1920) (Prostigmata: Trombiculidae)

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**Abstract:** Human dermatosis caused by the bite of trombiculid mite larvae, *Leptotrombidium intermedium*, was observed by exposing the larvae to the skin of two volunteers (A and B). A total of forty unfed larvae were exposed to the forearm of A. Six larvae bit, but five out of the six detached within 45 min. postinfestation. Only one larva enlarged, fully engorged, and detached itself by 66 hrs. postinfestation. On the site of the infestation, a vesicle with pain and itchiness appeared. A total of ninety unfed larvae were exposed to B. Only one out of ninety unfed larvae engorged and dropped off by 72 hrs. postinfestation. Instead of a vesicle, a small erythematous macule with slight pruritus was noticed at the bitten site. Moreover, the feeding period of infesting mites on human skin was almost the same as that on mice, but the infesting ratio to human skin was much lower than that of mice.

**INTRODUCTION**

The main vector mites of the Tsutsugamushi disease in Japan are considered to be three species, *Leptotrombidium akamu-shi*, *L. pallidum* and *L. scutellare* (Kawamura *et al.*, 1995). Recently, *Orientia tsu-tsugamushi* was detected and isolated from the unfed larvae of *L. intermedium*, collected from soil samples in the endemic areas (Urakami *et al.*, 2000). Consequently, this species was pointed out to possibly be one of the vectors of Tsutsugamushi disease in Japan. However, until now, it has not been known whether this species actually bites humans. In this study, the two volunteers (A and B) experimentally exposed unfed larvae of *L. intermedium* to their skin, and it was revealed that skin eruption was caused by this species.

**MATERIALS AND METHODS**

Fully engorged larvae of the *L. intermedium* were collected as described by Takahashi *et al.* (1988) from *Apodemus speciosus* and *Clethronomys rufocanus* captured in June 1992 in Nopporo Forest Park near Sapporo, Hokkaido, Japan. They were subsequently reared in our laboratory by feeding fresh eggs of the col-
lembolan *Sinella curviseta*. Twenty or thirty uninfected unfed larvae (F15) of *L. intermedium*, which were about 3 weeks old, were used for the experimental infestation to the underside of each left forearm of the two volunteers A and B. Both A (female, 51 years old) and B (male, 50 years old) have been rearing trombiculid mites in the laboratory for 11 and 17 years, respectively, and they also have considerable experience of having been bitten by various species of trombiculid mite larvae. As soon as the unfed larvae were exposed to the skin, a small petri dish of 3.0 cm in diameter and 1.5 cm in depth was placed to cover the area and was fixed with cellophane and surgical tapes. One hour after the exposure, the area was observed every 15 minutes. Then, it was further checked every 6 hours. To the volunteer A, 20 unfed larvae were exposed, and three days after this first exposure, 20 unfed larvae were exposed again. To the volunteer B, groups of 30, 20, 20 and 20 unfed larvae were exposed to the skin at intervals of 4, 4 and 6 days, respectively.

Meanwhile, the duration of the attachment to the skin and the number of mites which were recovered from it were compared with those in laboratory mice and accidental hosts (human). A total of 200 larvae, divided into 4 groups of 50 larvae, were exposed 4 times into the ear of each mouse as described by Takahashi et al. (1988) and then, the number and the period during which engorged larvae detached from the mouse were counted every 12 hrs. daily for a week.

**RESULTS**

The first experiment consisted of exposing 20 unfed larvae to the forearm of the volunteer A. At 30 min. postinfestation, one larva was found to be biting the skin, but at 45 min. postinfestation, the larva had left and disappeared. Three days after the first experiment, 20 larvae were exposed again. The larvae wandered over the infested volunteer's skin, but she did not feel any subjective symptoms. At fifteen min. postinfestation, two larvae bites were found, and at 30 min. postinfestation, a total of 5 larvae bites were observed. By 45 min. postinfestation, however, 4 larvae had detached from the skin. In the center of the pale anemic macula

Fig. 1. Larva of *L. intermedium* biting human skin.
A, 24 hours after the exposure. The larva looks like a red point (L) in the center of a vesicle (V); B, 48 hours after the exposure, enlarged larva (L) (about 200 µm in length and 100 µm in width) in the center of the vesicle (V) (about 3.0 mm in diameter and 2.0 mm in height), absorbing body fluid of the volunteer.
Table 1. The number and recovery rate of larval trombiculid mites, *L. intermedium* from the forearm of human beings.

<table>
<thead>
<tr>
<th>Recovery time (hours)</th>
<th>No. of mites exposed to the forearm of</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volunteer A</td>
<td>Volunteer B</td>
<td></td>
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<tr>
<td></td>
<td>20</td>
<td>20</td>
<td>30</td>
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<td>60</td>
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<tr>
<td>66</td>
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<td>1</td>
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</tr>
<tr>
<td>72</td>
<td>—</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>78</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Recovery rate (%)</strong></td>
<td>0</td>
<td>5.0</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Table 2. The number and recovery rate of engorged larval trombiculid mites, *L. intermedium* from the ear of mice.

<table>
<thead>
<tr>
<th>Recovery time (hours)</th>
<th>No. of mites exposed to the ear</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>48</td>
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<td>60</td>
<td>4</td>
<td>2</td>
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<tr>
<td>72</td>
<td>10</td>
<td>16</td>
<td>—</td>
</tr>
<tr>
<td>84</td>
<td>6</td>
<td>11</td>
<td>4</td>
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<td>96</td>
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<td>3</td>
<td>9</td>
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<td>108</td>
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<td>1</td>
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<tr>
<td>120</td>
<td>2</td>
<td>1</td>
<td>3</td>
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<tr>
<td>132</td>
<td>1</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>144</td>
<td>—</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>156</td>
<td>—</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>168</td>
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<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td><strong>Recovery rate (%)</strong></td>
<td>56.0</td>
<td>68.0</td>
<td>50.0</td>
</tr>
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</table>

(about 3 mm in diameter) at 12 hrs. postinfestation, one larva bite on the skin was observed as a minute red point under a stereomicroscope, and she felt a slight itchiness and pain at the bitten site. By twenty-four hrs. postinfestation, this larva had enlarged to some extent and the macule had increased in size and developed into a pruritic and painful vesicle with a very red point in the center (Fig. 1 A). By 48 hrs. postinfestation, this larva had enlarged more, then about 200 μm in length and 100 μm in width, having absorbed the body fluid of the volunteer, and the vesicle became enlarged to about 3.0 mm in diameter and 2.0 mm in height with an erythematous halo around it (Fig. 1B). Severe itchiness and pain increased rapidly. This fully engorged larva, 250 μm in length and 150 μm in width, detached from the skin by 66 hrs. postinfestation (Table 1). The pruritic vesicle lasted for several days, then subsided gradually leaving residual pigmentation for about one month.

In the other experimental infestation, a total of 90 larvae, divided into groups of 30, 20, 20 and 20 were exposed to the skin of the volunteer B. It was only in the first exposure out of the four that this species bit the human skin, that is, at sixty min. postinfestation, one larva bite was recognized. By 72 hrs. postinfestation, the engorged larva dropped off. In this case, only a small erythematous macule was observed with a slight itchiness, but no vesicle was observed. Meanwhile, in the case of experimental infestation of mice, 129 out of 200 (64.5%) larvae engorged and 22.5% of the engorged larvae were recovered between 60 and 72 hrs. after the infestation, followed by 15.5% between 84 and 96 hours. 1.5% of the engorged larvae were recovered between 144 and 156 hrs., and the period of feeding was the longest (Table 2).

**DISCUSSION**

About 30 species of larval trombiculid mites, involving the vector species of Tsutsugamushi disease, are known causes of
skin irritation, often very severe, and have a worldwide distribution (Alexander, 1984; Kawamura et al., 1995). In Japan, of more than 110 species of trombiculid mites recorded, eight species, *L. akamushi*, *L. pallidum*, *L. pallidum burnsi*, *L. scutellare*, *L. palpale*, *L. fiji*, *Eutrombicula wichmanni* and *Schoengastia hanmyaensis*, have been found to bite human beings (Kawamura, 1926; Asanuma, 1959; Suzuki, 1976). Larval trombiculid mites that bite human beings usually have a wide range of host preference, and the above eight species do not specifically prefer human beings. The duration of periods in which mites have bitten human skin differs among the mite species. Usually, engorge-ment of some species of larval trombiculid mites takes an average of 30 to 60 hours (Arai, 1955; Asanuma, 1959; Obata and Aoki, 1958; Takahashi et al., 1991), but the duration of periods in which the larvae of *L. intermedium* bite human skin and that of mice were longer than those observed by the investigators as mentioned above.

The infestation rate of *L. intermedium* exposed on human skin was 1.5% (2/130) in the present study, and it is fairly low compared with that of *L. scutellare* (15.0~40.0%) (Sasa et al., 1953; Kitaoka et al., 1953; Hayashi and Tanaka, 1955; Toriyama et al., 1988) and *L. akamushi* (15.2~42.9%) (Obata and Aoki, 1958; Takahashi et al., 1991).

The moment of actual invasion is usually unnoticed, and infested persons feel no itching and pain for 12 hours after exposure, although to some extent, a pale anemic macula about 2-3 mm in diameter may appear (Ito and Obata, 1961; Takahashi et al., 1991). The skin reaction of the bitten site differs among the mite species. When bitten by *L. scutellare*, victims feel itchiness for 3-4 days, and usually, mild erythematous skin irritation develops, but is often not noticed by the victims. With the volunteers for this study, careful observation revealed small papules or infiltrated erythema at the bitten sites (Arai, 1955; Sasa, 1956; Toriyama et al., 1988).

The bite of *E. wichmanni* causes severe itchy papules and is more painful than that of *L. scutellare*. Skin reactions caused by the bite of *L. palpale* are reported to be almost as painful as those caused by *L. akamushi* (Kadosaka, personal communication). As seen in the clinical pictures of the bites of *L. pallidum* and *S. hanmyaensis*, they are generally mild and the bites are hardly felt (Suzuki, 1976; Takahashi et al., 1991).

Stylostome formation is assumed to be one reason why skin reactions are different among larval trombiculid mites. Hase et al. (1978) recognized three types of stylostome formation in several species of *Leptotrombidium*. The stylostome formation of *L. intermedium* is referred to as the epidermal stylostome, which does not extend beyond the epidermal-dermal junction.

In the present experimental infestation, two larvae were observed to bite the human skin. Both volunteers, A and B, have been rearing trombiculid mite species for a long time, and they have been bitten many times by various species of unfed larvae. Nevertheless, the clinical pictures were different in the two cases. In the case of volunteer A, a vesicle formation was observed, which gradually enlarged. After the engorged larva dropped off, the vesicle lasted for several days. Then, residual eruption of the vesicle persisted with pruritus for about one month. Meanwhile, in the case of the other volunteer B, one larva bit, and by 72 hrs. postinfestation, the larva engorged and dropped off. A slight itchiness with no pain was felt, but no vesicle was seen. Therefore, vesicle formation of the volunteer A as mentioned above is suspected to result from an allergic reaction.

At any rate, our experimental infestations proved that the larvae of *L. intermedium* do bite human beings. Recently, *O. tsutsugamushi* was detected and also isolated from the unfed larval trombiculid mites of *L. intermedium*, and the infection rates in the endemic areas were 0.17% in
Kyoto and 0.68% in Niigata in an epidemiological study by Urakami et al. (2000). These findings indicate that it is possibly one of the vectors of Tsutsugamushi disease in Japan.

*Leptotrombidium intermedium* is a predominant species of trombiculid mites found in numbers on field rodents in northern Japan (Tamiya, 1962; Nakata, 1976). Moreover, this species is morphologically similar to *L. pallidum* which is an most important vector of Tsutsugamushi disease in Japan. When field surveys are carried out in endemic areas where these two species are sympatric, careful attention should be paid to identify the vector mite of this disease.

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**References**


Urakami, H., M. Takahashi, H. Misumi, K. Okubo, T.

摘要
アラトツツガムシによる皮膚炎
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アラトツツガムシ未吸着幼虫によるヒト刺咬性とその皮膚症状を被験者2名で観察した。被験者Aでは、飼育中の未吸着幼虫20個体を前腕腹側に放したところ、15分後に1個体が吸着しているのを気付いたが、まもなく離脱した。3日後に再度20個体を放したところ、30分後には5個体が吸着していたが、まもなく4個体が離脱した。しかし1個体だけは吸着し続け、12時間後には吸着部位にわずかな痒みと痛みを伴った直径3mmの紅斑が認められた。24時間後には、紅斑は痒みと痛みを伴った小水疱に変化し、48時間後には幼虫は体液を吸って膨潤した。この小水疱は直径約3mmに増大し、痒みと痛みはさらに強まった。66時間後には、十分に体液を吸ってしまう幼虫は、吸着部位から離脱したが、小水疱は数日間認められた。一方、被験者Bでは、4日または6日間の間隔で4回にわたり合計90個体を前腕腹側に放したところ、初回にのみ1個体が吸着し、72時間後までに満腹離脱した。吸着部位にはわずかな痒みを伴う紅斑が見られたものので、被験者Aでみられたような強い痛みや痛みなどは感じられず、小水疱も認められなかった。以上のことから、本種にはヒト刺咬性のあることが確認された。また吸着時間は、マウスで実験した場合とはほぼ同じであったが、ヒトに対する吸着率はマウスの場合に比べて大変低かった。