Clinical and Epidemiological Features of *Paederus* Dermatitis among Nut Farm Workers in Turkey

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Abstract. *Paederus* dermatitis is an acute irritant dermatitis resulting from contact with the hemolymph of *Paederus* beetles. This dermatitis mimics other infectious skin disorders, often resulting in diagnostic dilemmas. This study of 46 patients was conducted to increase awareness about *Paederus* dermatitis. Possible causes of a number of cases of *Paederus* dermatitis in Giresun, Turkey, were investigated using climate data and telephone interviews with the patients about risk factors. Insects caught by patients were identified at the species level. All patients were hazelnut farm workers and admitted to the hospital in the months during which the hazelnut harvesting occurs. Of the patients, 11 (23.91%) presented with painful and burning skin lesions, and 35 (70.09%) complained of itching. The neck was the most involved site (47.83%). The predominant type of lesion was erythematous plaque (84.78%). No pathological findings were detected by laboratory testing. Patients reported coming into contact with the insect during the daytime. Captured insects were identified as *Paederus fuscipes*. Although the weather and climate were optimal for *P. fuscipes* during June–October, patients were admitted to the hospital only during the hazelnut harvesting season (August–September). The only risk factor identified among patients was occupation; hence we believe our study is the first to suggest that *Paederus* dermatitis is an occupational disease among hazelnut farm workers. We suggest that *Paederus* spp. may become a substantial threat due to global warming, especially among farm workers. *Paederus* dermatitis is not included in classic medical textbooks. It is necessary to increase awareness about this condition.

INTRODUCTION

Paederus dermatitis is an acute irritant contact dermatitis caused by pederin, a hemolymph fluid released when *Paederus* beetles are crushed against the skin.^{1,2} These beetles are members of order *Coleoptera*, family *Staphylinidae* and genus *Paederus*,^{3,4} and are mainly found in regions with hot and humid climates.^{4,5} Various *Paederus* spp. causing *Paederus* dermatitis have been observed in the southwestern and southeastern United States, Hawaii, Italy, Nigeria, Sri Lanka, Venezuela, Tanzania, and Iran.¹ The prevalence of *Paederus* spp. in urban areas has resulted in them being regarded as pests, and there are often epidemics caused by these beetles during periods of increased rainfall. *Paederus* beetles exhibit positive phototaxis; they usually accumulate around artificial lights (especially fluorescent lighting) at night in wooded areas or in the city. Therefore, it is believed that patients with dermatitis are usually exposed to *Paederus* insects during the night.^{6,7}

Paederus dermatitis clinically manifests as pustules and vesicles on an erythematous base. Patients usually present with a sudden onset burning sensation and cutaneous pain.⁸ This blister dermatitis may be confused with viral and bacterial skin diseases, such as bullous impetigo, herpes simplex, and herpes zoster. Other diseases that must be considered as differential diagnoses are bullous or allergic contact dermatitis, liquid burns, and phytodermatitis.⁹ General medicine, ophthalmology, and dermatology textbooks do not include sufficient information about this clinical phenomenon.¹⁰ Obtaining detailed patient history and performing thorough physical examination are of paramount importance in diagnosing *Paederus* dermatitis. Clinical presentation during

warm and humid seasons, lack of dermatomal pain distribution, kissing lesions, and short recovery time are diagnostic findings indicative of *Paederus* dermatitis.^{11–14}

Giresun is located in the Black Sea region of Turkey. It has the second highest average rainfall in Turkey and a temperate climate.¹⁵ Hazelnut farming is the main economic activity of the local community. In this region, cases of *Paederus* dermatitis are frequently observed among nut farm workers during the annual hazelnut harvesting season. Patients frequently reported encountering the insect during the daytime. Furthermore, although the farm workers live in houses surrounded by hazelnut groves throughout the year, we observed that they were only admitted to our hospital during the nut harvest season, and specifically between August and October. Considering these specific findings, we decided to evaluate the epidemiologic and clinical manifestations of *Paederus* dermatitis in patients admitted to our hospital during the 2015 hazelnut harvesting season.

MATERIALS AND METHODS

Forty-six patients diagnosed with *Paederus* dermatitis in the dermatology clinic of our hospital between August and October 2015 were enrolled in the study. Detailed histories were obtained from each patient, including demographic data (age and sex) and clinical (season of admission, types of symptoms, localization, clinical appearance of lesions, and medications used). Digital photographs were taken. Characteristic clinical features included a predilection for exposed areas to be affected and the presence of kissing lesions and lesions with a linear appearance. Histories of cosmetic medication use, suspicious insect bites, burns, and systemic disease were obtained from all patients. Bacterial cultures, varicella-zoster virus (VZV), IgG and IgM antibody titers, potassium hydroxide preparations, and patch and Tzanck smear tests were performed to differentiate between *Paederus* dermatitis

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and other diseases such as impetigo, acute allergic or irritant contact dermatitis, herpes simplex, and herpes zoster.

In light of information obtained from the patients, possible causes of the *Paederus* dermatitis and its atypical presentation were investigated. Climate and weather data for 2015 were obtained from the Turkish State Meteorological Service, and all patients were questioned by telephone interview about risk factors (occupation, living in woodland areas, using artificial/fluorescent light, sleeping windows with open, sleeping without window or bed nets or protective clothing, sleeping on the floor, and pesticide and/or repellent use). The study was approved by the Ordu University local ethics committee.

Insects caught by the patients were identified at the species level using relevant dichotomous keys and a Zeiss Stemi 2000-C stereomicroscope (Zeiss, Germany), and images were captured using an SZPx microscope (Olympus, Japan) attached to a (×10) SPOT Insight QE camera (SPOT Imaging, Sterling Heights, MI) with advanced multi-shot capability.

RESULTS

Clinical features. A total of 46 patients, including 29 (63.04%) females and 17 (36.96%) males, were enrolled in the study. The median age was 47 years (range, 3–61 years). None of the patients had a history of systemic disease, burns, or cosmetic medication use.

Of the patients, 11 (23.91%) presented with painful and burning skin lesions with sudden onset and 35 (70.09%) presented with complaints of itching (Table 1). Two separate sites (neck and arms) were involved in three (6.52%)

TABLE 1
Clinical presentations of the cases

Clinical presentation	Number of cases (%)
Number of lesions	
1	43 (93.48)
2	3 (6.52)
Symptoms	
Itching	35 (70.09)
Burning	11 (23.91)
Neuralgia	11 (23.91)
Lesion sites	
Back of the neck	12 (26.09)
Neck	10 (21.74)
Arms	10 (21.74)
Shoulders	4 (8.70)
Axillary region	4 (8.70)
Lower limbs	3 (6.52)
Chest	2 (4.35)
Upper limbs	2 (4.35)
Face	1 (2.17)
Hip	1 (2.17)
Lesions features	
Erythema	39 (84.78)
Linear lesions	22 (47.83)
Vesicles	13 (28.26)
Pustules and papulopustules	11 (23.91)
Erosions	6 (13.04)
Kissing lesions	6 (13.04)
Treatments	
Topical steroid and fusidic acid	40 (86.96)
Antihistaminic agents	14 (30.43)
Nonsteroid anti-inflammatory drugs	11 (23.91)
Topical steroid	6 (13.04)
Topical anesthetics	1 (2.17)

patients, and the remaining 43 (93.48%) patients had a lesion at only one site. The neck was the most involved site, with 22 (47.83%) of the patients reporting neck involvement.

An erythematous plaque with the appearance of a burn was the predominant lesion identified (84.78%). In addition, linear *Paederus* dermatitis lesions, or dermatitis linearis, were identified in 47.83% of the patients (Figures 1 and 2); other common symptoms included pustules (23.91%), erosions (13.04%), and vesicles (28.26%) in the center of the erythematous plaque. Clinical manifestations of *Paederus* dermatitis usually include “kissing” or “mirror-image” lesions where two skin areas come into contact; these typical lesions were also observed in six (13.04%) of the patients (Table 1).

For VZV, IgM antibody titers were negative and IgG antibody titers were positive for all patients; however, when the IgG antibody tests were repeated, no increase was detected in antibody production, indicating no active VZV infection was present. Herpetic infection and impetigo were excluded, as acantholytic/multinucleated giant cells and aggregates of cocci were not detected by Tzanck smear examination. To identify fungal infections, potassium hydroxide preparations were performed, and all samples were negative. No pathogens were detected in bacterial cultures, and patch tests were negative.

Topical steroids alone (13.04%) and in combination with antibiotics (86.96%), topical (2.17%) or systemic (2.17%) analgesics, and antihistamines (30.43%) were prescribed for treatment of the patients (Table 1). All lesions healed with hyperpigmentation in 7–10 days.

Pathogen. Insects captured by the patients had a spindly appearance, had three pairs of thoracic appendages and were approximately 9 × 1.5 mm in length. The head and fifth and subsequent segments of the abdomen were black, whereas the pronotum and first four segments of the abdomen were red or dark orange, and the elytra were metallic blue. The first three segments of the antenna were yellowish red, and the color of the remaining antenna segments increasingly darkened into a reddish brown. The distal part of the maxillary palp, tarsus, and joints between the femur and tibia were blackish. Using relevant dichotomous keys, the insect was identified as *Paederus fuscipes* Curtis 1826^{16,17} (Figure 3).

Epidemiological study. Of the patients, 44 (95.65%) were small-scale farmers who earned their living cultivating hazelnuts farming on the Giresun coastline and two (4.34%)

FIGURE 1. Erythematous burn-like lesion with vesicles and pustules on a patient with *Paederus* dermatitis.

FIGURE 2. An erythematous lesion with erosion and superficial ulceration.

were children of these farmers. Patients were admitted to the hospital during the harvesting months, including August (36.96%), September (52.17%), and October (10.87%). All patients (100%) reported living in the houses surrounded by hazelnut groves and within heavily vegetated areas. Since their houses were predominantly single-storey buildings, 42 (91.30%) patients reported sleeping with the windows closed for protection from wild animals. Four (8.70%) patients reported living in buildings with at least two stories, sleeping with the windows open at night and using window nets. Three (6.52%) patients reported sleeping with lights on at night. Conversely, no patients reported using fluorescent lights in their houses. Although the window nets had been designed to protect individuals from mosquitoes and snakes, they also provided protection against insects. None of the patients reported using repellents, pesticides or bed nets, or wearing protective clothes. Patients were usually members of large families and reported sleeping on shakedown beds (89.13%). Thirty-two patients (69.57%) observed an insect on their skin and experienced a sudden burn during the daytime while picking hazelnuts. Factors associated with the increase of *Paederus* dermatitis are shown in Table 2.

When humidity and temperature trends and case distribution were analyzed by month, it was clear that the average temperature exceeded 20°C (the optimal temperature for the insect to forage) from June to October. Reproduction in *Paederus* spp. increases when the humidity level is high. The average humidity between July and October was determined to be 50%. The highest humidity was detected in September (54%) when the number of hospital admissions

FIGURE 3. *Paederus fuscipes*.

TABLE 2
Factor affecting associated with disease incidence

Factors	Affirmative reply n (%)
Living on farmland	46 (100)
Nut farm worker	44 (95.65)
Sleeping on the floor	41 (89.13)
Windows open during night	4 (8.69)
Window net use	4 (8.69)
Sleeping with artificial light	3 (6.5)
Use of fluorescent lamps	—
Pesticide with/without repellent	—
Wearing protective clothing	—
Bed net use	—

was also the highest. No hospital admissions were recorded in July, which was the month with the second highest humidity. Meteorological and *Paederus* beetle contact frequency data from 2015 are presented in Figure 4.

DISCUSSION

There are three families in the order Coleoptera that cause blister dermatitis. These families are Meloidae, Oedemeridae, and Staphylinidae. The vesicant chemical of insects in the Meloidae and Oedemeridae families is cantharidin, whereas that of insects in the Staphylinidae family, including *Paederus* spp., is pederin. *Paederus* dermatitis develops as a result of accidental contact with pederin, the hemolymph fluid of *Paederus* insects.^{3,18} manifests as inflammation, vesicles, and pustules.¹⁹ Because the proteases in pederin cause epidermal acanthosis, histopathological findings often indicate epidermal necrosis followed by prominent acanthosis.^{8,11,19}

The lesions manifest within 24–48 hours following contact between hemolymph and the skin. First, vesiculobullous lesions, characterized by itchy, erythematous, and necrotic bubbles occur. These lesions usually appear in the center of plaques and subsequently transform into pustules. During the healing period, new keratinocytes mature at the bottom of the pustules, and a crust is formed. “Dermatitis linearis” lesions are typical of this type of dermatitis.^{3,7,11} In our patients, erythematous plaques (84.78%) were the most commonly identified lesions. Pustules, erosions, vesicles, and dermatitis linearis were other frequently identified lesions, occurring in 23.91%, 13.04%, 28.26%, and 47.83% of patients, respectively.

Paederus dermatitis can heal naturally in a week or lead to various complications. These complications include postinflammatory

FIGURE 4. Meteorological and *Paederus* beetle contact frequency data (2015).

hyperpigmentation, secondary infections, extensive peeling of the skin, and ulcerous dermatitis requiring hospitalization.⁹ Fever, arthralgia, nausea, vomiting, and neuralgia can also be observed in severe cases.²⁰ Eleven (23.91%) of our patients were given nonsteroidal anti-inflammatory drugs for neuralgia. Topical steroids alone and in combination with antibiotics were used in 40 (86.96%) patients.

Paederus dermatitis lesions are commonly identified on exposed parts of the body and rarely encountered in ocular and genital areas. However, periorbital dermatitis, keratoconjunctivitis, and temporary blindness have also been reported.^{5,7,12,21} Ocular involvement was not identified in any of our patients; however, one patient (2.17%) had a facial lesion on the cheek just below the eye.

At present, approximately 600 *Paederus* spp. have been identified, of which 50 are known to cause contact dermatitis.⁴ *Paederus* insects are usually 7–10 mm in length and 0.5 mm in width⁵ and their bodies are very fragile. Although *Paederus* insects have wings, they prefer to run.²² Outbreaks of *Paederus* dermatitis have been attributed to several different *Paederus* spp. These include *Paederus melampus* in India, *Paederus brasiliensis* in North America, *Paederus colombius* in Venezuela, *Paederus peregrinus* in Indonesia, and *P. fuscipes* in Taiwan, Italy, and Iran.⁵ Turkey geographically neighbors both Middle Eastern and European countries. Although *P. fuscipes* has been identified during entomological studies in various European countries, clinical cases of *Paederus* dermatitis have only been reported in Italy.^{4,23} In our study, the species causing lesions was identified as *P. fuscipes*, similar to outbreaks that occurred in Italy and Iran⁵ (Figure 3).

Marshes, irrigated croplands, and wetland areas surrounding freshwater are ideal areas for the development of the immature stages of *Paederus* beetles. Algae, small insects, and decaying plant and animal material found in these habitats serve as sources of nutrition for the larvae. Adults feed on other insects and usually search for prey or rest on vegetation during the daytime. Artificial lights in living areas may attract adult beetles from habitats that are long distances away; therefore, contact with humans is believed to be especially frequent at night.^{10,24} Living in forested areas; using artificial, and especially fluorescent, light; sleeping with the windows open, not using window or bed nets; and sleeping with clothes that leave limbs exposed are documented risk factors.^{9,24} The Black Sea coast of Turkey contains plentiful water sources and has a forested and mountainous terrain. In these areas, local people make a living hazelnut farming, and the families of these workers live in homes surrounded by hazelnut groves throughout the year. Forty-four of our patients (95.65%) were hazelnut workers, and two (4.35%) were the children of hazelnut workers. Telephone interviews with these patients revealed that they mainly lived in single-storey houses and usually slept with the windows closed (91.30%) for protection from wild animals. Only four (8.70%) patients stated that they slept with the windows open; however, these patients were living in houses with at least two stories and using window nets for protection from mosquitoes and snakes. Furthermore, the three (6.52%) patients who reported sleeping with the lights on were included among those that used window nets. None of the patients reported using fluorescent lights in their homes. These findings indicate that exposure to insects at night was unlikely within this patient population.

Thirty-two (69.57%) patients described a sudden burning sensation and had observed insects while picking hazelnuts during the daytime. The majority of our patients were women ($N = 29$, 63.04%), and two (4.35%) patients were children. Agricultural workers in the Black Sea region are usually women who bring their children with them while working in the groves. We suggest that these two pediatric patients were also exposed to *P. fuscipes* while their parent was working.

Paederus spp. begin to search for food when ambient temperatures rise above 20°C. Increases in the number of *Paederus* beetles are correlated with increases in humidity.⁹ Ambient temperatures in Giresun usually exceed 20°C from May to October, and humidity is very high on the Black Sea coast of Turkey throughout the year.¹⁴ Although the average temperature was above 20°C during an almost 5-month period (June–October) in 2015, *Paederus* dermatitis patients were admitted to the hospital only between August and October, which is the hazelnut harvesting season. In addition, the average relative humidity exceeded 50% beginning in July; however, no cases were detected in July (Figure 4).

The best method for harvesting hazelnuts is to collect hazelnuts those dropped on the ground. However, the topography of the eastern Black Sea region requires collection of hazelnuts from the branches of trees. Detection of lesions mainly on the back of the neck (26.09%) and upper limbs (21.74%), contact with insects reported during the daytime while harvesting, and admission of the patients to hospital only between August and October, despite living in houses surrounded by hazelnut groves throughout the year, made us hypothesize that our patients were exposed to *P. fuscipes* while picking hazelnuts.

To our best knowledge, this the first study to suggest that *Paederus* dermatitis is an occupational disease among hazelnut farm workers. In our study, the number of cases was limited, because the hazelnut harvest season is very short in our region, and the zone investigated was small. Along with Turkey, hazelnuts are harvested in various countries including Spain, Italy, Australia, Austria, Canada, Chile, Azerbaijan, Georgia, the United States, Iran, China, France, Croatia, Kirghizstan, Poland, Greece, Belarus, Tajikistan, Uzbekistan, Russia, Armenia, Portugal, and India.²⁵ An international and multidisciplinary study including a larger sample size would further increase knowledge about this clinical phenomenon and determine more specifically the significance of *Paederus* dermatitis as an occupational disease.

We suggest that *Paederus* insects, which, thus far, have caused small outbreaks, of dermatitis, can affect larger populations, especially in regions with humid and temperate climates; thus, these insects could become a serious problem in agricultural areas with increased global warming. Since such predators are known as keystone species and may have a profound influence on the balance of organisms in a particular ecosystem, it will not be a rational solution to attempt to exterminate *Paederus* spp. Moreover these beetles should not be used by horticulturists in garden pest control as a natural biological agent. Therefore, it is necessary to raise awareness about *Paederus* insects, especially in societies engaged in agriculture. Hazelnut farm workers and persons traveling to endemic areas should be advised that, in case of exposure, they should gently remove the insect from the skin, wash the pederin-contaminated area

with plenty of water, and avoid touching their eyes. They should also be advised to keep doors and windows closed at night and sleep under a mosquito net. Through implementation of these measures, exposure can be prevented and complications can be minimized. *Paederus* dermatitis is not included in classic medical textbooks. Increased awareness among health professionals will enable early diagnosis and treatment and prevent unnecessary antimicrobial therapy due to misdiagnosis. To increase awareness in our local community, awareness-training programs were implemented under the guidance of local health authorities. Additionally, we plan to strictly monitor the number of *Paederus* dermatitis cases in the future years.

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