

## The Return of the Common Bedbug

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**Abstract:** The incidence of skin disease secondary to infestation with the human bedbug, *Cimex lectularius*, has increased dramatically in the United States and in the United Kingdom. We describe a child with a recurrent pruritic eruption of urticarial, erythematous papules on the face, neck, and extremities. The etiology of her cutaneous lesions was discovered to be a bedbug infestation in the home. The epidemiology, entomology, presentation, and treatment of bedbugs and their bites are discussed.

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*Cimex lectularius* feeds by perforating the skin of an unknowing sleeping human. Patients complain of recurrent, pruritic, erythematous papules on the exposed areas of the face, neck, and extremities. Lesions often present in a linear or clustered arrangement (1). The recent resurgence of infestation rates is the result of changes in foreign travel and pest control practices (2,3). To date, the bedbug is unable to transmit any known blood-borne pathogen to humans (4). Effective treatment is dependent upon thorough insect extermination (5).

### CASE REPORT

A healthy 10-year-old Caucasian girl from central Virginia was evaluated for an intensely pruritic eruption, which had been present for 3 months. According to her parents, the lesions began on the lower extremities and spread to involve her buttocks, bilateral upper extremities, chest, and neck. No other family members were affected. One month after the onset of skin lesions, a punch biopsy specimen from the left buttock was obtained and was interpreted to be consistent with an arthropod reaction. All

attempted treatments including several short courses of oral corticosteroids, oral antihistamines, oral antibiotics, topical permethrin, antibiotic ointments, and mid-potency corticosteroid creams were unsuccessful.

Physical examination revealed a healthy-appearing girl with multiple erythematous papules and macules in various stages of evolution over all four extremities. Some lesions were distributed in a linear arrangement and several had evidence of excoriation. A few discrete urticarial papules were appreciated along the left arm and neck. The face, trunk, and mucous membranes were uninvolved.

A second punch biopsy specimen was obtained from the left proximal upper extremity. Histologic examination demonstrated a mildly hyperkeratotic epidermis with minimal spongiosis and a prominent, dense, mixed superficial and deep perivascular and interstitial infiltrate within the dermis. The infiltrate was composed predominately of eosinophils. No arthropod structure was identified. This pattern was felt to be most consistent with papular urticaria secondary to arthropod bites.

Despite mild symptomatic improvement with short-term high-potency topical corticosteroids and nightly

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oral antihistamines, the patient continued to develop new lesions. Several weeks later, the patient's mother discovered several web pages about bed bugs on the internet, and based on their suggestion, examined her child's bed with a flashlight in the middle of the night. She discovered several small 5 mm flat brown bugs. The wingless insects were taken for entomologic identification to the local university extension service and found to be *Cimex lectularius*, the commonly known bedbug. Following appropriate eradication of the infestation by an exterminator, the skin lesions began to heal and there were no new bites. Severe postinflammatory hyperpigmentation at the sites of previous bites is resolving, but slowly. The mother now attributes the appearance of bedbugs in the household to either stuffed animals her daughter won at a carnival and brought home or to a 2-week vacation in Florida, just prior to the onset of the problem.

### DISCUSSION

The common bedbug, *Cimex lectularius*, is a nocturnal, bloodsucking ectoparasite that attacks humans, birds, bats, and other mammals (1,6–8). The existence of *Cimex lectularius* is referenced in both the ancient Greek (Aristophanes) and Latin (Horace) literature (9). The Romans named the insect *cimex* which means bug, and *lectularius*, the descriptive adjective pertaining to a bed or couch.

Skin lesions secondary to *Cimex lectularius* were common in the United States until the 1940s. During that decade, the advent of modern insecticides, most notably dichlorodiphenyltrichloroethane (DDT), led to the virtual disappearance of this cutaneous problem. However, since 1995 pest management and hospitality professionals have noticed an increase in bedbug-related complaints (10).

Experts support several causes for the recent resurgence in bedbugs in the United States. One theory attributes the influx of bedbugs to a rise in international tourism. The US Department of Commerce reported a record 51 million international tourists in 2000, a 15% increase over a period of 5 years. A heightened awareness of this problem has developed in the state of Florida (where there has been a 10-fold increase in bedbug pesticide services), and in the major US cities of Atlanta, New York, and San Francisco (11–15). Similar increased rates of infestation have been observed in the United Kingdom and Brazil (3,16–18).

A separate theory implicates the change in pesticide management over the past several decades. DDT and organophosphates, carbamates, and pyrethroids have been replaced by the use of less toxic insect-specific bait gel traps and hormonal growth regulators. This has resulted in suppression of the bedbug's natural predators



**Figure 1.** *Cimex lectularius* feeding on a human host. Note bedbug size compared to hair follicles (Courtesy of Clemson University Department of Entomology, Cooperative Extension Service).

(the cockroach, red ant, and certain spider species). In addition, the bedbug itself is unaffected by current insect control methods (1,11–13).

The bedbug is a flat 5 mm oval, brown, wingless insect possessing six legs (Fig. 1). Following its blood meal, the insect is engorged and mahogany-red. Each female can produce approximately 200 eggs in a lifetime. Following mating and feeding, the female lays three to four pearly white 1 mm eggs, and cements them to rough surfaces within dark crevices (6,19,20). *Cimex* belongs to the family of "true bugs" known as Cimicidae and develops through four nymphal stages and five molts over the course of 6 weeks. A full meal must precede each molting (21). All generations can be present in a single room, making eradication extremely difficult (15). An adult bedbug can survive for 12 months without blood, its sole form of nutrition, and up to 2 years in cooler environments. Males starved for longer than 2 weeks will cease to mate (22).

Bedbugs emerge only at night and inhabit concealed dry hiding places (i.e., mattresses, furniture, floorboard cracks, wallpaper pockets, suitcase seams) in homes, restaurants, theaters, buses, and camping shelters. The *Cimex* is unable to attach itself to its host, yet it can travel by lodging itself within the dark crevices of personal belongings (4,23). Contrary to many other insect habitats, the cleanliness of the environment has minimal influence in site selection. The major attractants appear to be both human body temperature and carbon dioxide production (6,24,25). The unknowing host receives a painless bite, often during the predawn hours (26). The bedbug feeds, not unlike the mosquito, by piercing the host's skin with one jagged pair of stylets derived from the maxilla. A

second pair of stylets consists of a set of tubes through which an anticoagulant (an inhibitor of the conversion factor X to factor Xa), a vasodilator (nitric oxide), and proteolytic enzymes (apyrase) are administered onto the skin wound. A combination of blood and saliva is then consumed in a retrograde fashion (27–32). Approximately 30 minutes of attachment is required to complete a full feeding (25).

The immunologic status of the host seems to determine the resultant cutaneous reaction (33). In most patients, small purpuric macules develop into erythematous indurated papules. There may be a central punctum at the sites of inoculation. Lesions usually occur on exposed areas of the face, neck, and extremities, and resolve over the course of 2 weeks with residual postinflammatory hyperpigmentation (34). The skilled observer may also detect a linear or cluster configuration of three to four lesions (i.e., breakfast, lunch, and dinner). Urticarial perilesional plaques and localized bullous site reactions have also been documented (35–38). Pruritic wheal reactions, which are most prominent in the morning and resolve over the course of the day, represent a Type I hypersensitivity reaction elicited by the parasite's saliva antigen (39). Anaphylactoid reactions have also been reported (40,41). Severe reactions, both delayed and serum sickness presentations, are more likely to occur with repeated attacks (42,43). The clinical differential diagnosis may include drug reaction, allergic contact dermatitis, atopic dermatitis, Gianotti–Crosti syndrome, pityriasis lichenoides et varioliformis acuta, ecthyma, scabies infestation, and dermatitis herpetiformis (36,44).

Children, especially atopics, are more likely to develop papular urticaria, a hypersensitivity reaction characterized by autoeczematization and diffuse pruritus (26,44,45). Vigorous scratching and concomitant erosions predispose the skin to secondary bacterial infection and possible scar formation (46). Asthmatic patients can demonstrate increased sensitivity to antigens found in bedbug dung (47). Chronic *Cimex* infestation can cause nervousness, lethargy, pallor, diarrhea, and eventual iron deficiency (13,48).

The role of *Cimex lectularius* as a vector for blood-borne pathogen transmission continues to be investigated. Controlled scientific studies have demonstrated in vivo incubation of organisms carrying approximately 20 different human illnesses, including leishmaniasis, American trypanosomiasis, rickettsia, pasteuria, tularemia, yersinia, Q fever, plaque, relapsing fever, leprosy, oriental sore, and brucellosis (10,49–53). To date, no substantial evidence of transmission of these organisms from bedbugs to humans has been recorded (4,15,54).

During the 1970s, both hepatitis B and E antigens were detected in bedbugs following inoculation of infected human sera (55–59). A recent laboratory study has revealed

the continued presence of these viral antigens within the insect for 6 hours (60). The intracellular milieu of the *Cimex* has been shown to lack the required proteins necessary for viral replication, making viral transmission highly unlikely (61,62). Analogous conclusions have been drawn regarding the bedbug as a vector for human immunodeficiency virus transmission. The absence of T4 antigen on the insect's cell surface has been postulated to prohibit HIV replication (63–66).

Clues to the presence of bedbugs include discrete reddish-brown bloodstains on sheets and mattresses, as well as flecks of excrement at the portals of hiding places. With high insect loads, an intense sweet malodor, caused by large amounts of parasitic oil secretion, can be detected (26). The severity of home infestation can often be determined by delineating the central "hotspot," such as a mattress, and inspecting in an outwardly radial fashion. The farther the distance (i.e., a nearby room or window curtains on an opposing wall), the more challenging the eradication process (15). Special nocturnal searches are often required, as the definitive diagnosis depends upon collection and identification of the bedbug (17,67).

Cutaneous management is conservative, directed primarily at ameliorating the patient's symptoms. Topical medium-strength corticosteroids and appropriate wound care for superficial erosions are usually adequate. Sedating low-dose oral antihistamines can be given to decrease pruritus, especially at night. Secondary infection is an indication for appropriate oral antibiotic therapy (68). Bullous skin reactions may be treated with short courses of oral corticosteroids (35). Rare cases of anaphylaxis require acute intervention by emergency personnel (41).

Education is the most effective treatment for bedbug management (13). Employing effective insecticide measures and controlling the importation of unknown furniture and baggage will successfully eliminate infestation. A careful history may uncover exposure risk (i.e., vacation spots, recreational facilities, acquisition of antiques, rodent exposure, recent visitors) (69). Measures should be taken to eliminate neighboring bat and bird habitats because they act as refuge sites following eradication (70). Both the infested and adjoining rooms should be inspected and treated meticulously. This often requires vacuuming, caulking wall holes and floor crevices, discarding old furniture, and dismantling and spraying mattress components with insecticides (5). Appropriate chemicals (i.e., malathion, pyrethrin, dichlorvos, permethrin, and diethyltoluamide) must make direct contact with all affected surfaces (21,39,71–73). Confirmation of live *Cimex* 2 weeks after appropriate treatment measures is indicative of continued infestation (69). When amateur efforts fail, the services of a professional exterminator may be required.

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