

What's Eating You? Carpet Beetles (Dermestidae)

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PRACTICE POINTS

- Given their ubiquity, dermatologists should be aware of the potential for hypersensitivity reactions to carpet beetles (Dermestidae).
- Pruritic erythematous papules, pustules, and vesicles are the most common manifestations of exposure to larval hairs.
- Treatment is symptom based, and future exposure can be greatly diminished with thorough cleaning of the patient's environment.

Carpet beetle larvae of the family Dermestidae have been documented to cause both acute and delayed hypersensitivity reactions in susceptible individuals. These larvae have specialized horizontal rows of spear-shaped hairs called hastisetae, which detach easily into the surrounding environment and are small enough to travel by air. Exposure to hastisetae has been tied to adverse effects ranging from dermatitis to rhinoconjunctivitis and acute asthma, with treatment being mostly empiric and symptom based. Due to the pervasiveness of carpet beetles in homes, improved awareness of dermestid-induced manifestations is valuable for clinicians.

Beetles in the Dermestidae family do not bite humans but have been reported to cause skin reactions in addition to other symptoms typical of an allergic reaction. Skin contact with larval hairs (hastisetae) of these insects—known as carpet, larder, or hide beetles—may cause urticarial or edematous papules that are mistaken for papular urticaria or arthropod bites.¹ There are approximately 500 to 700 species of carpet

beetles worldwide. Carpet beetles are a clinically under-recognized cause of allergic contact dermatitis given their frequent presence in homes across the world.² Carpet beetle larvae feed on shed skin, feathers, hair, wool, book bindings, felt, leather, wood, silk, and sometimes grains and thus can be found nearly anywhere. Most symptom-inducing exposures to Dermestidae beetles occur occupationally, such as in museum curators working hands-on with collection materials and workers handling infested materials such as wool.^{3,4} In-home Dermestidae exposure may lead to symptoms, especially if regularly worn clothing and bedding materials are infested. The broad palate of dermestid members has resulted in substantial contamination of stored materials such as flour and fabric in addition to the destruction of museum collections.⁵⁻⁷

The larvae of some dermestid species, most commonly of the genera *Anthrenus* and *Dermestes*, are 2 to 3 mm in length and have detachable hairlike hastisetae that shed into the surrounding environment throughout larval development (Figure 1).⁸ The hastisetae, located on the thoracic and abdominal segments (tergites), serve as a larval defense mechanism. When prodded, the round, hairy, wormlike larvae tense up and can raise their abdominal tergites while splaying the hastisetae out in a fanlike manner.⁹ Similar to porcupine quills, the hastisetae easily detach and can entrap the appendages of invertebrate predators. Hastisetae are not known to be sharp enough to puncture human skin, but friction and irritation from skin contact and superficial sticking of the hastisetae into mucous membranes and noncornified epithelium, such as in the bronchial airways, are thought to induce hypersensitivity reactions in susceptible individuals.

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The authors report no conflict of interest.

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Cutis. 2024 March;113(3):E6-E9. doi:10.12788/cutis.0979



FIGURE 1. Dermestid larva. Horizontal rows of dark setae are visible on the larva. Thin lines are millimeter demarcations.

Additionally, hastisetae and the exoskeletons of both adult and larval dermestid beetles are composed mostly of chitin, which is highly allergenic. Chitin has been found to play a proinflammatory role in ocular inflammation, asthma, and bronchial reactivity via T helper cell (T_H2)–mediated cellular interactions.¹⁰⁻¹² Larvae shed their exoskeletons, including hastisetae, multiple times over the course of their development, which contributes to their potential allergen burden (Figure 2). Reports of positive prick and/or patch testing to larval components indicate some cases of both acute type 1 and delayed type 4 hypersensitivity reactions.^{4,8,13}

Clinical Presentation and Diagnosis

Multiple erythematous urticarial papules, papulopustules, and papulovesicles are the typical manifestations of dermestid dermatitis.^{3,4,13-16} Figure 3 demonstrates several characteristic edematous papules with background erythema. Unlike the clusters seen with flea and bed bug bites, dermestid-induced lesions typically are single and scattered, with a propensity for exposed limbs and the face. Exposure to hastisetae commonly results in classic allergic symptoms including rhinitis, conjunctivitis, coughing, wheezing, sneezing, and intranasal and periorcular pruritus, even in those with no personal history of atopy.¹⁷⁻¹⁹ Lymphadenopathy, vasculitis, and allergic alveolitis also have been reported.²⁰ A large infestation in which many individual beetles as well as larvae can be found in 1 or more areas of the inhabited structure has been reported to cause more severe symptoms, including acute eczema, otitis externa, lymphocytic vasculitis, and allergic alveolitis, all of which resolved within 3 months of thorough deinfestation cleaning.²¹

Skin-prick and/or patch testing is not necessary for this clinical diagnosis of dermestid-induced allergic

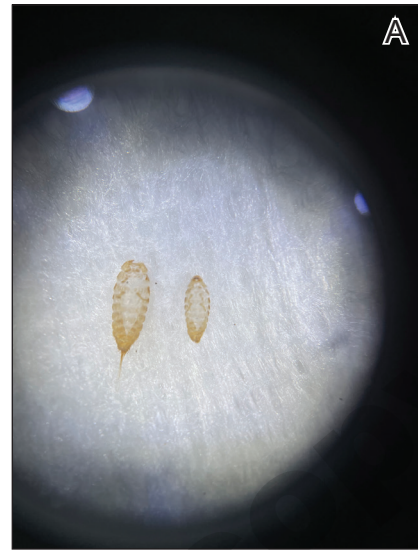


FIGURE 2. A and B, Molted exoskeletons of dermestid larvae.

contact dermatitis. This diagnosis is bolstered by (but does not require a history of) repeated symptom induction upon performing certain activities (eg, handling taxidermy specimens) and/or in certain environments (eg, only at home). Because of individual differences in hypersensitivity to dermestid parts, it is not typical for all members of a household to be affected.

When there are multiple potential suspected allergens or an unknown cause for symptoms despite a detailed history, allergy testing can be useful in confirming a diagnosis and directing management. Immediate-onset type 1 hypersensitivity reactions are evaluated using skin-prick testing or serum IgE levels, whereas delayed type 4 hypersensitivity reactions can be evaluated using patch testing. Type 1 reactions tend to present with classic allergy symptoms, especially where there are abundant mast cells to degranulate in the skin and mucosa of the



FIGURE 3. A and B, Edematous papules on the face with background erythema from dermestid larva contact.

gastrointestinal and respiratory tracts; these symptoms range from mild wheezing, urticaria, periorbital pruritus, and sneezing to outright asthma, diarrhea, rhinoconjunctivitis, and even anaphylaxis. With these reactions, initial exposure to an antigen such as chitin in the hastisetæ leads to an asymptomatic sensitization against the antigen in which its introduction leads to a T_H2 -skewed cellular response, which promotes B-cell production of IgE antibodies. Upon subsequent exposure to this antigen, IgE antibodies bound to mast cells will lead them to degranulate with release of histamine and other proinflammatory molecules, resulting in clinical manifestations. The skin-prick test relies on introduction of potential antigens through the epidermis into the dermis with a sharp lancet to induce IgE antibody activation and then degranulation of the patient's mast cells, resulting in a pruritic erythematous wheal. This IgE-mediated process has been shown to occur in response to dermestid larval parts among household dust, resulting in chronic coughing, sneezing, nasal pruritus, and asthma.^{15,17,22}

Type 4 hypersensitivity reactions are T-cell mediated and also include a sensitization phase followed by symptom manifestation upon repeat exposure; however, these reactions usually are not immediate and can take up to 72 hours after exposure to manifest.²³ This is because T cells specific to the antigen do not lead a process resulting in antibodies but instead recruit numerous other T_H1 -polarized mediators upon re-exposure to activate cytotoxic $CD8^+$ T cells and macrophages to attempt to neutralize the antigen. Many type 4 reactions result in mostly cutaneous manifestations, such as contact

dermatitis. Patch testing involves adhering potential allergens to the skin for a time with assessments at regular intervals to evaluate the level of reaction from weakly positive to severe. At minimum, most reports of dermestid-related manifestations include a rash such as erythematous papules, and several published cases involving patch testing have yielded positive results to various preparations of larval parts.^{3,14,21}

Management and Treatment

Prevention of dermestid exposure is difficult given the myriad materials eaten by the larvae. An insect exterminator should verify and treat a carpet beetle infestation, while a dermatologist can treat symptomatic individuals. Treatment is driven by the severity of the patient's discomfort and is aimed at both symptomatic relief and reducing dermestid exposure moving forward. Although in certain environments it will be nearly impossible to eradicate Dermestidae, cleaning thoroughly and regularly may go far to reduce exposure and associated symptoms.

Clothing and other materials such as bedding that will have direct skin contact should be washed to remove hastisetæ and be stored in airtight containers in addition to items made with animal fibers, such as wool sweaters and down blankets. Mattresses, flooring, rugs, curtains, and other amenable areas should be vacuumed thoroughly, and the vacuum bag should be placed in the trash afterward. Protective pillow and mattress covers should be used. Stuffed animals in infested areas should be thrown away if not able to be completely washed and dried. Air conditioning systems may spread larval hairs away from the site of infestation and should be cleaned as much as possible. Surfaces where beetles and larvae also are commonly seen, such as windowsills, and hidden among closet and pantry items should also be wiped clean to remove both insects and potential substrate. In one case, scraping the wood flooring and applying a thick coat of varnish in addition to removing all stuffed animals from an affected individual's home allowed for resolution of symptoms.¹⁷

Treatment for symptoms includes topical anti-inflammatory agents and/or oral antihistamines, with improvement in symptoms typically occurring within days and resolution dependent on level of exposure moving forward.

Final Thoughts

There is a broad overlap between dermestid habitats and human-occupied environments; thus, the opportunities for exposure and sensitization to allergenic dermestid parts are numerous. Dermatologists should be aware of the possible manifestations from dermestid exposure.

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