

Short communication

Occupational rhinoconjunctivitis and asthma in a wool worker caused by Dermestidae spp.

Background: The family Dermestidae belongs to the order Coleoptera. Occupational allergy has been described in museum personnel. A 31-year-old male wool worker presenting rhinoconjunctivitis and asthma episodes probably linked to exposure to Dermestidae-infected wool was investigated.

Methods: Extracts prepared either from insect bodies or from dust from parasitized wool were used for skin prick testing (SPT), conjunctival and bronchial provocation tests and *in vitro* determinations.

Results: SPT and provocation tests were positive to both extracts. PEFR measurement demonstrated the association between the patient's symptoms and occupational exposure to Dermestidae. Specific IgE to both extracts was detected and immunoblotting revealed several protein bands from 5 to 200 kDa that were reactive to IgE from the patient's serum.

Conclusions: Dermestidae exposure in wool workers when handling parasitized wool can be a cause of IgE-mediated rhinoconjunctivitis and asthma.

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Occupational allergy in furriers was first described in 1988, affecting up to 5% of exposed workers. Their symptoms are related to the inhalation of fur dust, as occurs in the case of allergy to laboratory animals (1).

Fur stored before industrial tanning can be contaminated by insects from the Dermestidae family and lead to hypersensitivity reactions. In 1922, Loir and Leganoux (2) described 'a severe pruritic, erythematous and vesiculating eruption on the exposed parts of the skin, and dry and hacking cough' in stevedores who were unloading a cargo of bones from a ship. They were found to be infested with Dermestidae larvae. Rhinitis and asthma episodes after Dermestidae exposure in museum personnel has been described (3). In another group of museum personnel, Dermestidae exposure was demonstrated to be the cause of occupational symptoms (conjunctivitis, sneezing, cough, dyspnoea, wheezing and dermatitis) (4).

The family Dermestidae belongs to the order Coleoptera and includes about 600 species. Most of them feed exclusively on animal products. The insects are 1.5–10 mm in size and are densely covered with hairs or scales. Adults and larvae can seriously damage leather, fur, wool, carpets or plant products.

Material and methods

Clinical case

A 31-year-old man, who has been working as a wool worker for 10 years, presented 2 years ago nasal and ocular pruritus, conjunctival hyperaemia, sneezing, aqueous rhinorrhoea, nasal obstruction, cough, wheezing and dyspnoea episodes. His crises occurred from April to June and were related to the reception and handling of sheep wool in a wool factory.

Extracts

Parasitized wool from the factory was partially turned into a kind of dust containing small live insects of about 1–4 mm. These were identified by an entomologist (Natural History Museum, Madrid) as belonging to the family Dermestidae, order Coleoptera. The species could not be identified.

Two different extracts (Dermestidae whole bodies and dust from parasitized wool) were prepared in phosphate buffered saline (PBS) at 5% w/v with a potter. They were centrifuged and, after dialysing, were sterilized through a 0.22-µm pore diameter membrane. Protein concentration was determined by the method of Lowry. Part of the extract was 50% glycerinated for skin prick test (SPT). Another part was adjusted to 1 mg protein/ml for the conjunctival and specific bronchial provocation test (BPT). The rest of the extract was used for *in vitro* studies and stored at –18°C until use.

Cutaneous tests

The SPT was performed according to the method of the Subcommittee on Skin Tests of the European Academy of Allergology and Clinical Immunology using standardized lancets (Dome Hollister Stier, West Haven, CT, USA) (5).

Initially, SPT was carried out with a standard battery of aeroallergens, including: mites (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Lepidoglyphus destructor*, *Tyrophagus putrescentiae*, *Acarus siro*, *Euroglyphus maynei*, and *Gohieria fusca*); pollen (*Lolium perenne*, *Dactylis glomerata*, *Cynodon dactylon*, *Olea europaea*, *Plantago lanceolata*, *Artemisia vulgaris*); fungi (*Alternaria alternata*, *Cladosporium herbarum*, *Aspergillus fumigatus*); dander (cat, dog and sheep); and cockroach (*Blattus germanica*, *Periplaneta americana*). This was followed by SPT with Dermestidae whole body and dust from parasitized wool extracts at a concentration of 2.5% (w/v) (about 1 mg protein/ml). Histamine hydrochloride at 10 mg/ml and glycerol-saline solution were used as positive and negative controls, respectively. To rule out possible irritative properties of Dermestidae extracts, 10 control subjects (five wool workers and five healthy subjects) were also tested.

Conjunctival provocation test

This test was performed according to the method described by Moller et al. (6). Briefly, the concentrated extract (both Dermestidae whole body and dust) for the test was prepared at 1 mg protein/ml. Serial dilutions were carried out at 0.001, 0.01, and 0.1 mg/ml.

Bronchial provocation test

A BPT with methecolina was conducted using the procedure and concentrations proposed by Chatman et al. (7), recording vital capacity, FEV₁ and PEFR values with a Jäger spirometer. Dilutions were administered with a Hudson 1720 nebulizer with input and output flow rates of 7 l/min and 0.28–0.30 ml/min, respectively.

A peak-flow meter was given to the patient to carry out daily morning and night measurements for 3 months, indicating the working days and periods out of work.

A specific BPT was performed with both extracts basically according to Chai et al. (8), with some modifications. The patient was tested when asymptomatic and a FEV₁ of more than 80% of the normal predicted value was found. A control challenge with PBS was carried out before antigen challenge. The patient was skin tested with concentrations of 0.0001, 0.001, 0.01, 0.1 and 1 mg protein/ml of Dermestidae extract to determine a safe starting dose for the provocation test, and this concentration was found to be 0.001 mg/ml (10-fold lower than the one that produced a 3 × 3 mm wheal). The patient inhaled the aerosolized allergen in

progressively increasing concentrations (0.001, 0.01, 0.1, 1 mg/ml) for 2 min at tidal volume. FEV₁ and PEFR were measured after each inhalation and also 5, 10, 15, 30 and 60 min later. To assess the late bronchial response, the patient himself monitored PEFR values in parallel to spirometry recordings by means of a portable Mini-Wright type peak-flow meter for up to 24 h. A positive test response was defined as a drop in FEV₁ of 20% or in PEFR of 25% from the post-diluent value during early or late determinations. Two asymptomatic wool workers and two atopic patients with mild asthma were also challenged with the same extract as the control subjects.

Specific IgE determination

Specific IgE was determined by the RAST technique. Solid-phase antigen was obtained by coupling the extract proteins to BrCN-activated paper disks according to the method of Ceska et al. (9). Disks were incubated with 50 µl of the patient's serum and then with 100 000 cpm of ¹²⁵I-anti-IgE mAb HE-2 (10). *Lolium* disks and four dilutions of a grass-specific serum pool, calibrated against the Pharmacia Phadebas[®] RAST system, were used as reference. In addition, specific IgE to mites (*D. pteronyssinus*, *D. farinae*, *L. destructor*, *T. putrescentiae* and *A. siro*) and cockroach (*B. germanica*) was determined by the CAP method (Pharmacia CAP System, Pharmacia & Upjohn Diagnostics AB, Uppsala, Sweden).

IgE-immunoblotting

Tricine-SDS-PAGE was carried out in a 10–20% polyacrylamide gel (Novex, San Diego, CA) using non-reducing conditions. Two hundred µg of extract protein were loaded per lane. The parasite extract proteins, separated by SDS-PAGE, were electrotransferred onto PVDF membranes. After blocking with 5% BSA in PBS, the membranes were incubated with a 1/5 dilution, in 1% BSA-PBS, of the patient's serum and then with 1/3000 dilution of mouse anti-human IgE mAb HE-2 ascitic fluid. After incubating with a rabbit anti-mouse IgG conjugated with peroxidase (Dako Diagnósticos, Barcelona, Spain), immunodetection of IgE-binding proteins was achieved by enhanced chemiluminescence (ECL) following the manufacturer's instructions (ECL, Amersham, UK). As negative control, one blot with parasite proteins transferred was incubated with dilution buffer instead of with the patient's serum.

Results

Our patient showed positive SPT to whole body from Dermestidae and dust from parasitized wool extracts (Fig. 1). SPT responses to a battery of commercially available inhalants were positive to *Artemisia vulgaris*.

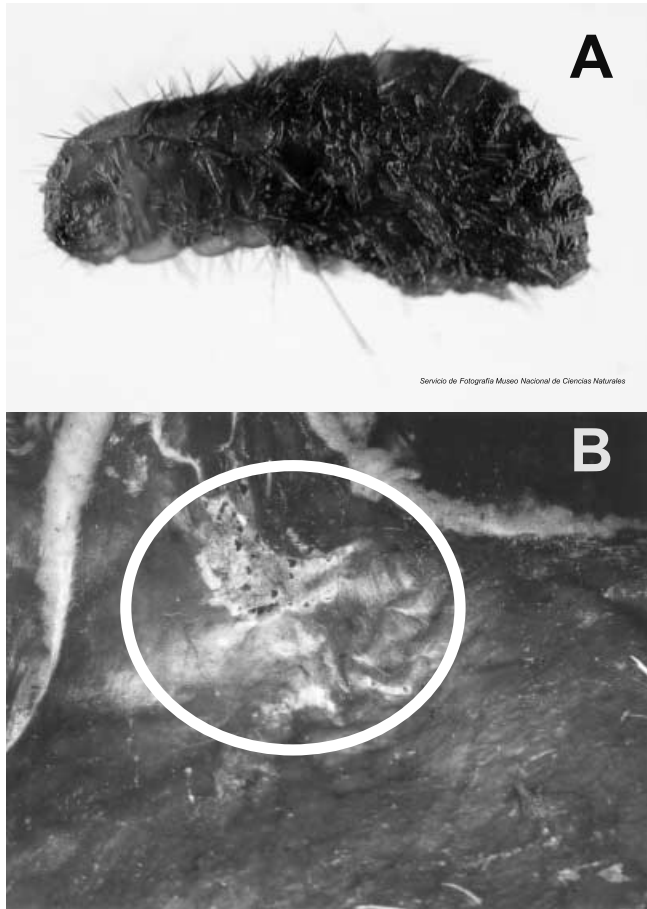


Figure 1. A. A member of the family Dermestidae. B. Wool parasitized by Dermestidae. Highlighted area shows the insect-contaminated wool.

The nonspecific BPT response to methecolina, performed in an asymptomatic period (November), was negative.

Conjunctival provocation test responses were positive to an antigen concentration of 0.001 mg/ml.

Peak flow monitoring at work and at home indicated occupational asthma; PEFR varied 20–42% during working days and 9–13% during days off, although the patient used regular budesonide 800 µg inhalations and salbutamol 200 µg per day.

The BPT response to Dermestidae body extract, at a concentration of 0.01 mg/ml, was positive with recordings decreasing to 38% FEV₁ and 34% PEF₁, respectively. The BPT response to the extract of parasitized wool dust was also positive at the same concentration, with a decrease to 21% FEV₁ and 27% PEF₁, respectively. No late asthmatic reaction was detected by the peak-flow meter during the 24 h after the BPT.

None of the control subjects (atopic and exposed to wool) had positive responses in SPT, conjunctival tests and BPTs.

Specific IgE to Dermestidae (body and dust from parasitized wool) was positive (0.9 kU/l and 1.4 kU/l, respectively), although negative to mites and cockroach.

The SDS-PAGE profile (Fig. 2A) and IgE-immunoblotting (Fig. 2B) of Dermestidae body and dust wool extracts showed several protein bands from 5 to 200 kDa that were reactive to IgE from the patient's serum. The most active bands had apparent molecular weights of about 5, 20 and 30 kDa. No differences were observed between insect body and dust wool extracts.

Discussion

We report here the case of a wool worker who experienced episodes of rhinitis, conjunctivitis and asthma related to his work of handling sheep wool. The results indicate an IgE mechanism (IgE-mediated rhinoconjunctivitis and asthma (11)) as demonstrated by SPT, specific IgE determination, and conjunctival and bronchial provocation tests to Dermestidae (wool parasite) body and dust from parasitized wool extracts. In addition, the monitoring of PEFR during working days also demonstrates the association between his symptoms and occupation.

IgE-immunoblotting experiments revealed the presence in the patient's serum of IgE against several protein

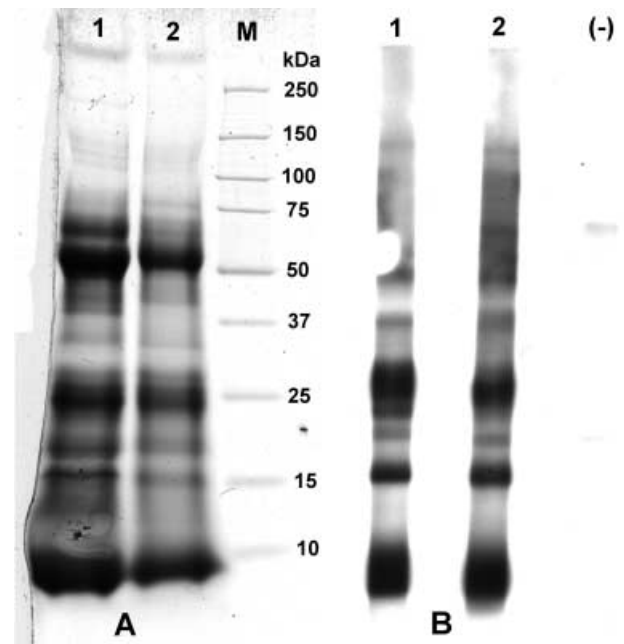


Figure 2. A. SDS-PAGE. 1: Dermestidae whole body extract. 2: Dust extract. 3: Molecular weight markers. B. IgE-immunoblotting with patient's serum. 1: Whole body extract. 2: Dust extract. 3: Negative control. The positions of the pre-stained molecular weight markers, run in parallel, are indicated on the right.

bands, mainly of 5, 20 and 30 kDa. No differences were observed between insect body and dust from parasitized wool extracts, thus suggesting that the patient's sensitization occurred through inhalation of insect particles from the dust.

Zuskin and co-workers described the high prevalence of respiratory occupational symptoms in furriers exposed to dust in their workplace. Most of them suffered from cough (50%), sinusitis (30%), dyspnoea (25%), nasal catarrh (20%) and occupational asthma (only 5%). The author considers that environmental dust in the workplace and animal dander are the causes of occupational symptoms in those patients (1).

However, our patient's symptoms are limited to May and June, when sheep wool is extracted and its organic remains can be parasitized by Dermestidae. When parasitized wool is handled, Dermestidae particles can become airborne and inhaled by workers. In 1941, Sheldon and Johnston (3) described a similar occupational case caused by Dermestidae in a museum worker who was exposed to these Coleoptera through the skeletons prepared by allowing Dermestidae larvae to feed on the rotten flesh. The patient had observed that asthma symptoms occurred when entering the room where that process was carried out. Skin tests conducted with extracts prepared

from adult, larvae and excretion products from Dermestidae were all positive. In addition, the nasal provocation test was positive.

In the home environment, the role of Dermestidae insects in the onset of respiratory symptoms has also been demonstrated. Cuesta et al. (12) reported the case of a patient with rhinitis and asthma caused by Dermestidae insects found on the parquet floor of the house. The skin tests, specific IgE and specific bronchial provocation tests were positive. Abengózar (13) reported another case of a patient with bronchial asthma caused by Dermestidae insects, also through parasites detected on the parquet floor of the house. The crises disappeared after applying insecticides and replacing the wooden floor with tiles. In this case, IgE-immunoblotting revealed that the polypeptides with allergenic capacity all had a molecular weight between 4 and 22 kDa. In the immunoblot performed with our patient's serum, proteins of compatible molecular weight were also detected among the allergenic polypeptides.

It is necessary to consider Dermestidae allergy when attending a wool worker with respiratory symptoms. Further epidemiological studies in wool workers should be conducted to determine the prevalence of respiratory occupational allergy to Dermestidae.

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