

Editorial

Does occupational exposure to insects lead to species-specific sensitization?

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Insect and insect-derived materials have been implicated as a risk factor for sensitization and subsequent elicitation of allergic rhinitis and bronchial asthma (1–5). In the early 1930, the role of insects in allergy was mainly investigated in a series of isolated cases in which the inhalant allergen was related to insects present in outdoor environments or workplaces. Moreover, it was also demonstrated that insect emanations during the June to September period are largely represented in the outdoor environment, suggesting that, similar to pollen allergens, insects and insect-derived materials represent an important source of inhalant allergens (6–7). More recently, several authors demonstrated that house dust contain significant concentration of insect allergens and that the exposure to relevant insects can also occur in dwelling environments (8–9).

Epidemiological and prevalence studies of insect sensitization in randomly selected subjects and in insect allergic patients have been covered in a large number of articles; in some studies, the influence of the environments in relation to the climate and various species of insects is also taken into account. The conclusions of these papers highlight the high frequencies of subjects reactive to insects, and indicate a broad range of reactivity in relation to climatic conditions, being the tropical and subtropical zones of those areas showing the highest prevalence of allergy to insects (10).

Moreover, several patients developed allergic rhinitis and bronchial asthma after occupational exposure to insects in breeding and research establishments, underlining the importance of the insects also among occupational diseases (11).

Examples of occupational allergy to insects have been reported among entomologist or laboratory workers to beetles, cockroaches, locusts, blowflies, crickets, moths and flies. Agricultural and industrial workers have

experienced allergic symptoms from bean weevils, grain weevils, mushroom flies, sewer flies, houseflies, silk worms and fish bait such as larvae of flies, moths and worms. Flour moths and beetles can be the source of 'flour allergy'. Occupational flour exposure occurs mainly in bakeries and mills, but flour is also used in several other industries, such as confectionery, agriculture, animal-feed manufacturers and malt making (12). As for other allergies, it can be concluded that there are two kinds of occupational exposures: the first one involves a direct and careful handling of insects, whereas the second one foresees an accidental exposure because the workplace is infested by insects or insect-derived materials. In the former kind of exposure, a reasonable protection against insects can be achieved (e.g. masks, gloves, increasing ventilation and gowns to be worn in the work area), whereas for accidental exposure the number of precautionary measures available is very little.

The case report by Focke et al., in the May 2003 issue of the Journal, describes a case history of a patient whose allergic symptoms were referable to airborne housefly allergens in occupational setting (13). A 30-year-old female farmer with a long-lasting history of grass pollen allergy had experienced rhino-conjunctivitis and asthma for 2 years when entering livestock stables and barns infested by the common housefly (*Musca domestica*). The patient herself suspected the flies as the cause of symptoms. Skin prick test and specific immunoglobulin E (IgE) revealed positive reactions essentially to grass pollen and *M. domestica*. However, no reaction was elicited by animal danders, *Blattella germanica*, *Dermatophagoides pteronissinus*, *Acarus siro*, *Lepidoglyphus destructor*.

The molecular weights (MWs) of the allergens were established by Western blotting with the patient's serum. The *M. domestica* extract was characterized by three bands with MWs 70, 50 and 16 kDa, respectively.

Housefly tropomyosin was detected by a tropomyosin reference serum but not by the patient's serum suggesting that the occupational exposure to housefly did not elicit sensitization to this important invertebrate panallergen. Moreover the authors evaluated the cross-reactivity at the IgE level among different insects by enzyme-linked immunosorbent assay (ELISA) inhibition experiments. Although several allergenic components have been identified as responsible for the cross-reactivity among insects, Focke et al. found that the patient had a restricted reactivity at the family level of the true flies (*Muscidae*).

Only a few publications have described allergic reactions to the common housefly (14–16). In these cases, the sensitization appears to be the result of the exposure to a large number of houseflies in occupational environments such as livestock stables, barns and fly-rearing room in a research station. The sensitization status of such allergic patients would seem restricted to houseflies only.

In 1985, an interesting paper by Tee et al. (15) reported a case of a female scientific worker in whom *M. domestica* provoked rhinitis with IgE antibody in her serum. Moreover, the authors, using an immunochemical method previously developed by Agarwal et al. (21) measured fly-allergen concentration in the cage dust and in atmosphere of the fly rearing room. Even if the latter approach needs more investigation, the atmospheric sampling in workplaces could become an important tool to determine the critical concentrations of airborne allergens necessary to elicit allergic diseases. Taken together, previous reports and the latest by Focke et al. suggest that the housefly sensitization may be highly specific with only little cross-reactivity to other insects. Similar reports dealing with occupational type I allergy to other insects confirm that the sensitization may be specific to the individual insect species present in the working environments (17–20).

However, studies suggesting that there is a general cross-reactivity among household insects (panallergy) including houseflies and other arthropods especially mites have been published, and it is difficult to determine whether a patient has multiple sensitivities because of multiple arthropod exposure or widespread invertebrate

cross-reactivity (10, 22–24). In these studies, a true sensitization to various insect allergens was not clearly demonstrated, and the apparent polysensitization was mainly associated with IgE cross-reactivity with other environmental allergens to which the subjects may have been exposed. Galindo et al. (25) provide data supporting this conclusion. The authors compared a group of patients with occupational type I allergy to red midge larva with a group of subjects sensitized to red midge larva but who had not apparently exposed to this allergen. Whereas the group with occupational exposure showed IgE reactivity to chironomids only, the patients belonging to the group of unexposed subjects had IgE reacting against other allergen such as *D. pteronyssinus*, shrimp and/or common mosquito. The analysis of the immunoblotting reactivity revealed that the occupationally exposed patients seemed to have IgE against Chi t 1, the major Chironomus allergen, whereas the group without specific exposure recognized several components in Chironomus, mosquito, shrimp and *D. pteronyssinus* extracts showing equivalent molecular weights. The authors conclude that the unexposed patients were sensitized to Chironomus as a result of cross-reactivity with other insect or crustacean species.

In conclusion, the insect allergy can include a natural and an occupational exposure. Besides the difficulty to identify which insects or insect-derived debris are spread in a natural environment, a broad cross-reactivity among arthropods and a consequent polysensitization of the patients hamper the identification of a particular insect as source of sensitization in a natural exposure. Moreover, in an occupational setting the allergenic source is easily detectable and identifiable, and it would seem that an occupational and consequent heavy exposure restricted to a single insect species would elicit sensitization toward species-specific allergens.

For these reasons, occupational allergy to insects could also be regarded as a valuable model to better elucidate the relationship between exposure to insect inhalant allergens and clinically significant symptoms in sensitized atopic individuals.

References

1. PERLMAN F. Insects as inhalant allergens. Consideration of aerobiology, biochemistry, preparation of material, and clinical observation. *J Allergy* 1958;**28**:302–328.
2. FEINBERG AR, FEINBERG SM, BENAÏM-PINTO C. Asthma and rhinitis from insect allergens I. Clinical importance. *J Allergy* 1956;**27**:437–444.
3. WISEMAN RD, WOODIN WG, MILLER HC, MYERS MA. Insect allergy as a possible cause of inhalant sensitivity. *J Allergy* 1959;**30**:191–197.
4. PANZANI RC. Inhalant allergy to arthropods (to the exclusion of mites) (Part I). *Allergol Immunopathol* 1994;**22**:28–38.
5. PANZANI RC. Inhalant allergy to arthropods (to the exclusion of mites) (Part II). *Allergol Immunopathol* 1994;**22**:167–177.
6. PARLATO SJ. Emanations of flies as exciting causes of allergic coryza and asthma. III Hypersensitiveness to moth and butterflies. *J Allergy* 1932;**3**: 125–138.
7. BALYEAUT RM, STEMEN TR, TAFT CE. Comparative pollen, mold, butterfly and moth emanation content of the air. *J Allergy* 1932;**58**:227–234.
8. SWANSON MC, AGARWAL MK, REED CE. An immunochemical approach to indoor aeroallergen quantitation with a new volumetric air sampler: studies with mite, roach, cat mouse, and guinea pig allergens. *J Allergy Clin Immunol* 1985;**76**:724–729.

9. WITTEMAN AM, VOORNEMAN R, VAN DEN OUDENRIJN S, VAN LEEUWEN J, AKKERDAAS J, VAN DER ZEE JS et al. Silverfish protein in house dust in relation to mite and total arthropod level. *Clin Exp Allergy* 1996;**26**:1171–1176.
10. PANZANI RC, ARIANO R. Arthropod and invertebrates allergy (with the exclusion of mites): the concept of panallergy. *Allergy* 2001;**56**(Suppl. 69):1–22.
11. KANG B, CHANG JL. Allergenic impact of inhaled arthropod material. *Clin Rev Allergy* 1985;**3**:363–375.
12. MAKINEN-KILJUNEN S, MUSSALO-RAUHAMA H, PETMAN L, RINNE J, HAAHTELA T. A baker's occupational allergy to flour moth (*Ephesia kuehniella*). *Allergy* 2001;**56**:696–700.
13. FOCKE M, HEMMER W, WÖHRL S, GÖTZ M, JARISCH R, KOFLER H. Specific sensitization to the common housefly (*Musca domestica*) not related to insect panallergy. *Allergy* 2003;**58**:448–451.
14. JAMIESON HC. The house fly as a cause of nasal allergy. *J Allergy* 1938;**9**:273–274.
15. TEE RD, GORDON DJ, LACEY J, NUNN AJ, BROWN M, NEWMAN TAYLOR AJ. Occupational allergy to the common house fly (*Musca domestica*): use of immunologic response to identify atmospheric allergen. *J Allergy Clin Immunol* 1985;**76**:826–831.
16. WAHL R, FRAEDRICH J. Occupational allergy to the housefly (*Musca domestica*). *Allergy* 1997;**52**:236–238.
17. PERLMAN F. Insect allergens, their interrelation and differences. *J Allergy* 1961;**32**:93–101.
18. BAGENSTOSE AH, MATHEWS KP, HOMBURGER HA, SAAVEARD-DELGADO AP. Inhalant allergy due to crickets. *J Allergy Clin Immunol* 1980;**65**:71–74.
19. BERNSTEIN DI, GALLAGHER JS, BERNSTEIN IL. Mealworm asthma: clinical and immunologic studies. *J Allergy Clin Immunol* 1983;**72**:475–480.
20. TEE RD, GORDON DJ, HAWKINS ER, NUNN AJ, LACEY J, VENABLES KM et al. Occupational allergy to locusts: an investigation of the sources of the allergen. *J Allergy Clin Immunol* 1988;**81**:517–525.
21. AGARWAL MK, YUNGINGER JW, SWANSON B, REED CE. An immunochemical method to measure atmospheric allergens. *J Allergy Clin Immunol* 1981;**68**:194–200.
22. MARTINEZ A, MARTINEZ J, PALACIOS R, PANZANI R. Importance of tropomyosin in the allergy to household arthropods. Cross-reactivity with other invertebrate extracts. *Allergol Immunopathol* 1997;**25**:118–126.
23. REESE G, AYUSO R, LEHRER SB. Tropomyosin: an invertebrate pan-allergen. *Int Arch Allergy Immunol* 1999;**119**:247–258.
24. GALINDO PA, LOMBARDERO M, BORJA J, GOMEZ E, FEO F, BARBER D et al. A new arthropod panallergen? *Allergy* 2001;**56**:195–197.
25. GALINDO PA, LOMBARDERO M, MUR P, FEO F, GOMEZ E, BORJA J et al. Patterns of immunoglobulin E sensitization to chironomids in exposed and unexposed subjects. *J Invest Allergol Immunol* 1999;**9**:117–122.