

IgE antibodies to house dust, mite, animal allergens and moulds in house dust hypersensitivity

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Summary

Fifty-three patients were investigated by intradermal tests and Phadebas RAST and, in most cases, the serum IgE level was determined. They were tested for sensitivity to house dust, *Dermatophagoides pteronyssinus*, cat, dog, horse and mould allergens.

All cases with IgE antibodies to house dust were found to have specific IgE to other tested allergens as well. Eighty-nine per cent of the patients being RAST positive for house dust were also positive for *D. pteronyssinus* and in the majority of those cases IgE antibodies to other allergens were detected. The results reaffirm previous findings that the mite is not the only allergen in house dust and that extract of house dust is a mixture of several allergenic substances, which make it less suitable for differential testing.

It is concluded that serum IgE determination is of value as a screening procedure in the diagnosis and that the use of a number of specific allergens in RAST is valuable in pinpointing the offending allergen in house dust hypersensitivity.

Introduction

At the beginning of the century it was already suggested that a certain but unknown allergen was present in house dust. Several attempts to isolate partially purified house dust allergen fractions and isolation of house dust allergen were unsuccessful. The mite *Dermatophagoides pteronyssinus* was shown to be a source of the house dust allergen through the work of the Dutch group of allergologists headed by Voorhorst (Voorhorst, Spieksma-Boezeman & Spieksma, 1964; Voorhorst *et al.*, 1967). The mite was described by Trouessart in 1897 (in Voorhorst *et al.*, 1967) but was still not very well known. Although these important findings have been verified by other authors, house dust extracts are widely used in allergy diagnosis. Such extracts must be considered as a mixture of numerous allergen components and impossible to standardize. It can be assumed that the house dust consists of an always changing composition of various biological materials such as animal dander, pollen, mould spores etc.

The aim of the present study was to investigate whether patients having positive

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skin tests to house dust extracts were in fact sensitive to allergens assumed to be present in normal house dust extracts, such as house dust mite (*Dermatophagoides pteronyssinus*) animal epithelia and moulds, and to compare skin test and RAST results.

Materials and methods

Patients and allergens

Fifty-three patients with suspected house dust hypersensitivity were included in the study. Serum samples were analysed with Phadebas RAST® (Pharmacia Diagnostics AB, Uppsala, Sweden) with respect to IgE antibodies to the following allergens: house dust, *Dermatophagoides pteronyssinus*, cat epithelium, dog epithelium and horse dander. Twenty-five of the sera were also tested in RAST for *Aspergillus fumigatus*, *Cladosporium herbarum* and *Penicillium notatum*. One sample was tested with respect only to house dust, mite and the moulds.

The Phadebas RAST allergen discs were prepared from raw materials purchased from Allergon AB, Engelholm, Sweden, except the house dust and the mite, where extracts manufactured by Hollister-Stier Laboratories, U.S.A., and Bencard, Brentford, Middlesex, England, respectively were applied.

The extracts of *Cladosporium* and *Penicillium* used for the skin tests were prepared by Dr L. Yman, Pharmacia Diagnostics AB (Virchow *et al.*, 1975). The skin test extract of *D. pteronyssinus* was prepared according to the Frugoni method described previously (Virchow & Debelic, 1970). The remaining extracts for skin tests were purchased from Bencard.

Skin tests

All patients were tested intracutaneously with the above mentioned antigens. The skin tests were carried out with those concentrations usually applied and the skin reactions were evaluated in relation to a reaction caused by a 0.0001 g/ml histamine dihydrochloride solution (Virchow & Debelic, 1970).

In vitro tests

Before the skin testing procedure a blood sample was drawn from each patient. Serum was prepared and kept at -20° C until determinations of serum IgE and IgE antibodies were performed.

Total serum IgE. The serum IgE level was estimated in forty-nine of the patients by means of the radioactive single radial diffusion method (Rowe, 1969).

IgE antibodies in serum. Duplicate analyses were carried out with Phadebas RAST (Wide, Bennich & Johansson, 1967). The results were expressed in five classes according to the Phadebas RAST reference system, where class 0 is considered to be a negative response. Classes 1-4 indicate the presence of circulating IgE antibodies in increasing amounts.

Results

Comparison between skin tests and RAST

The total agreement between intradermal tests and RAST for house dust was 68% (Table 1).

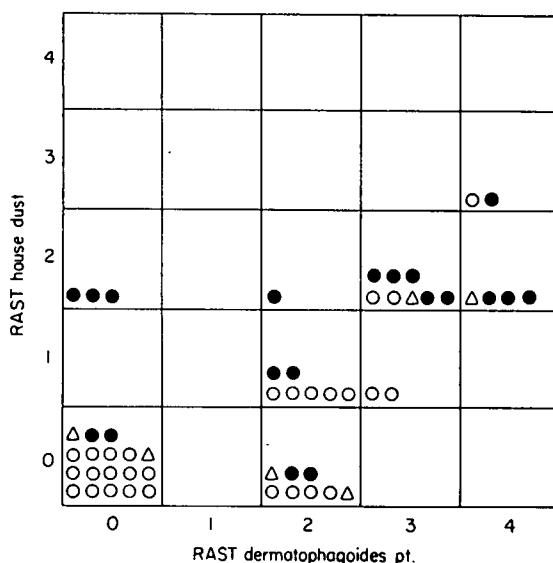


Fig. 2. Comparison between RAST responses with regard to house dust and *Dermatophagoides pteronyssinus*. ○, RAST class 0 for all other allergens tested for; ●, RAST class 1–4 for animal allergens; ▲, RAST class 1–4 for moulds (class 0 for animal allergens).

Table 2. RAST responses to house dust compared with RAST results for other allergens. The figures indicate the number of cases

House dust		<i>Dermatophagoides pteronyssinus</i>		Cat		Dog		Horse		Moulds		
				RAST class		RAST class		RAST class		RAST class		not
RAST class	Number	RAST class	Number	0	1-4	0	1-4	0	1-4	0	1-4	tested
0	26	0	18	16	2	16	2	18		5		10
		1-4	8	8		7	1	7	1	3	4	1
1-4	27	0	3		3	2	1	1	2	1	1	1
		1-4	24	13	11	21	3	22	2	3	5	16

antibodies to house dust. Eighteen of them were likewise found in class 0 for mite but four sera were found to contain IgE antibodies to other allergens tested for.

In eight sera RAST detected IgE antibodies to the mite but not to house dust. Four of them were positive also in RAST for other allergens.

Twenty-seven patients had specific IgE to house dust allergens and twenty-four (89%) of those were also RAST positive for the mite (Fig. 2). The remaining three had, however, specific IgE to other allergens, all of them to cat epithelium (Table 2). Of the twenty-four cases which were recorded in Phadebas RAST classes 1-4 for both house dust and *D. pteronyssinus* ten sera (42%) had detectable IgE antibodies only to those two of the allergen preparations tested for. Twelve of the remaining had reaginic antibodies to animal allergens, most of them to cat epithelium (Table 2) and the additional two were RAST positive for moulds.

Totally thirty-two patients had circulating IgE antibodies to *D. pteronyssinus* and in fourteen (43%) this was the only allergen (house dust excluded) to which reagins were detected.

The total RAST score for the group of twenty-seven patients with positive RAST for house dust was on an average 4.8 when mite and animal epithelia were concerned. The corresponding figure for the ten cases with RAST class 0 for house dust was 2.8. The two mean values were significantly different, $P < 0.05$.

Total serum IgE

The serum IgE level was lower for the patients with negative RAST (geometric mean 266 U/ml) than for those with circulating IgE antibodies to the tested allergens (Fig. 3).

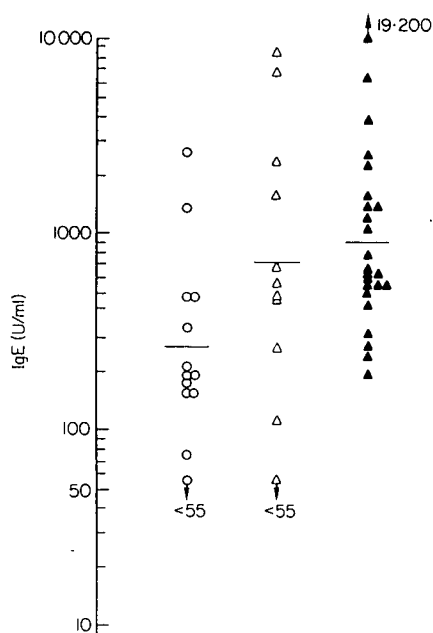


Fig. 3. Total serum IgE levels in three groups of patients. ○, RAST class 0 for all allergens tested; △, RAST class 0 for house dust but classes 1-4 for one or more other allergens; ▲, RAST classes 1-4 for house dust as well as other allergen(s).

The line indicates the geometric mean.

The group with positive RAST to house dust had, however, no significantly different IgE level than the group that was RAST negative for house dust but positive to other allergens. Both groups had a few very high IgE values (> 6000 U/ml). All of them had circulating IgE antibodies to at least two of the mould species tested in RAST.

Discussion

The overall correlation of 68% between skin test results and Phadebas RAST for house dust obtained in this study seems low in comparison with the considerably better agreements reported from studies on other allergens (Ahlstedt *et al.*, 1974; Berg & Johansson, 1974). However, lower figures of correlation for house dust have previously been published (Aas & Johansson, 1971). The reason why the correlation

between the two test systems is not so high for house dust is apparently the use of unstandardized and non-characterized heterogeneous extracts. As long as well defined extract preparations are not available a full correlation can not be expected. It is a striking feature in the present material that 39% of the positive skin tests were combined with negative RAST for house dust. Most of them, however, were positive in RAST for other allergens tested for, e.g. *Dermatophagoides pteronyssinus*. Many investigators have shown the close correlation between allergens in house dust and the house dust mite (Voorhorst *et al.*, 1964; Pepys, Chan & Hargreave, 1968; McAllen, Assem & Maunsell, 1970; Romagnani *et al.*, 1972; Biliotti, Romagnani & Ricci, 1975). There are, however, reports that there is no correlation between house dust hypersensitivity and reactions to *D. pteronyssinus* (Stenius, 1973). It is evident that mite allergens are not the only allergenic substances in house dust (Kawai *et al.*, 1972; Bernstein & Safferman, 1973). The few cases in the present study who were skin test positive for house dust but RAST negative for all the allergens included in the panel might very well have circulating specific IgE to allergens not tested, e.g. further animal epithelia and moulds or other biological substances. Non-specific intradermal test reactions or the involvement of short term IgG antibodies (Parish, 1970) in the skin may of course be applicable also to those cases.

The present observation that the RAST response for *D. pteronyssinus* is generally higher than that for house dust is in accordance with previous findings (Miyamoto *et al.*, 1974). The explanation may again be the impure state of the house dust extract, where the concentration of mite allergens may not be high enough to detect a low concentration of specific IgE to mite when the house dust discs are used in RAST. In fact the difference in total RAST scores for mite and animal allergens between the groups with and without positive RAST for house dust supports this explanation. In cases, where the reagin titre is low for specific allergens connected to house dust or present only for one or a few such allergens, the total concentration of IgE antibodies may be too low to be detected with the house dust discs on which only minor concentrations of some allergens may be coupled.

Virchow and Debelic (1970) reported that 95% of patients hypersensitive to house dust were skin sensitive to extracts of *D. pteronyssinus*. This is in accordance with the present findings with RAST where 89% of patients with detectable specific IgE to the allergens in the house dust extract also had reagins to the mite. In this patient material, *D. pteronyssinus* seemed to be the only causal factor in 43% of those with positive RAST to the mite. In the remaining cases there were also specific IgE to other allergens. These figures are in good agreement with those obtained by Virchow (1972) from skin and provocation tests.

The fact that some house dust hypersensitive patients had no IgE antibodies to mite but to other allergens tested for in RAST again suggests, that the mite is not the only allergen in house dust. The assumption, however, that for example animal epithelial or mould allergens are responsible for such positive RAST responses for house dust has to be verified by inhibition experiments. Such studies are in progress.

All the patients investigated in this study who were RAST positive to house dust were also positive to at least one of the other allergens tested. This suggests that no case was missed in the diagnosis by using RAST for a number of house dust connected allergens. Rather a more specific diagnosis was attained than if house dust had been used alone.

Even if the mean IgE value for the RAST negative group was lower than the group

in whom IgE antibodies were detected by RAST, it still contained a few cases with elevated serum IgE values. Possible allergy to other allergens not in the present study may explain these high IgE values. A more pronounced discrimination between the allergic and non-allergic groups may have been obtained, if sensitive radioimmunoassay methods, e.g. Phadebas IgE Test or PRIST (Ceska & Lundkvist, 1972), had been used. They are reported to give lower values of serum IgE than those previously published (Johansson, Berglund & Kjellman, 1976 and Kjellman, Johansson & Roth, 1976). The serum IgE determination seems to be a valuable screening procedure in the diagnosis of allergy to house dust allergens.

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