Acta Derm Venereol (Stockh) 1985; Suppl. 114: 109–112

Allergy to Hen's Egg White in Atopic Dermatitis

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Clinical parameters of 84 egg-allergic children were recorded. The individual allergens in hen's egg white were studied by means of crossed radio-immunoelectrophoresis (CRIE). Thirteen of the proteins in the egg white were found to have given rise to IgE-antibody production in the egg-allergic children. The major allergens were identified as ovalbumin, ovomucoid and ovotransferrin. Pruritus and exacerbation of atopic dermatitis were the symptoms of egg allergy most frequently recorded. A clear association was found between egg allergy and atopic dermatitis and can be explained on basis of the relationship that seems to exist between atopic dermatitis and high levels of total IgE in serum. This relationship is discussed. *Key words: Allergens; Crossed radioimmunoelectrophoresis; Total IgE.*

During the last fifty years numerous authors have observed that reaginic antibodies against proteins in hen's egg white are frequently found in patients with atopic dermatitis (1, 2, 3, 4). The etiological significance of this, and of food allergy in general in atopic dermatitis, is however, still a source of disagreement (5).

To explore this field, we have carried out the present immunological and clinical studies in egg-allergic children.

MATERIAL AND METHODS

Quantitative immunoelectrophoretic methods, such as crossed immunoelectrophoresis (CIE), CIE with intermediate gel, crossed line immunoelectrophoresis and rocket immunoelectrophoresis, were performed as described in detail earlier (6, 7, 8).

Crossed radioimmunoelectrophoresis (CRIE) was performed as described elsewhere (7), incubating CIE-slides with 68 single sera from egg-allergic children. After washing, the slides were incubated with I^{125}-anti IgE (Pharmacia, Sweden), and finally placed faced-down on X-ray films for autoradiography (7).

Radio-allergosorbent test (RAST). Specific IgE-antibodies against hen's egg white were determined using RAST-kits according to the manufacturer's instructions (Pharmacia, Sweden).

Paper radio-immunosorbent test (PRIST). Total IgE in egg-allergic and control sera was determined using PRIST-kits (Pharmacia, Sweden), as described before (7).

Protein separation. Various egg-white proteins were partially purified by combining quantitative immunoelectrosphoresis and biochemical separation-techniques (ion-exchange chromatography, gel filtration and precipitation with ammonium sulphate) as described earlier (8).

Egg-allergic patients. 84 egg-allergic children, aged 1–15 years, admitted to the Children's Asthma and Allergy Institute, Voksentoppen, were studied. The allergy-diagnosis was based upon history, radio-allergosorbent test (RAST) and skin prick test (SPT). To be included in the study, a positive RAST to egg white, corresponding to RAST-class 2 or more was required.

Atopic control patients. A control group was also included, consisting of 72 children with various atopic diseases, but with egg-tolerance and negative RAST to egg white. The control group was matched with the egg-allergic group with respect to sex and age (10).

Clinical study. The various symptoms of egg allergy were recorded. The egg-allergic group and the atopic control group were compared with respect to degree of bronchial asthma (9), degree of atopic dermatitis (10), incidence of allergic rhinitis and degree of allergy to cow's milk and fish, graded as "yes", "doubt" or "no". Further details about the clinical study are described elsewhere (10).

Study of subgroups. The parameters described above were also studied in two subgroups within this material. These subgroups consisted of 22 patients each, one egg-allergic, and another egg-

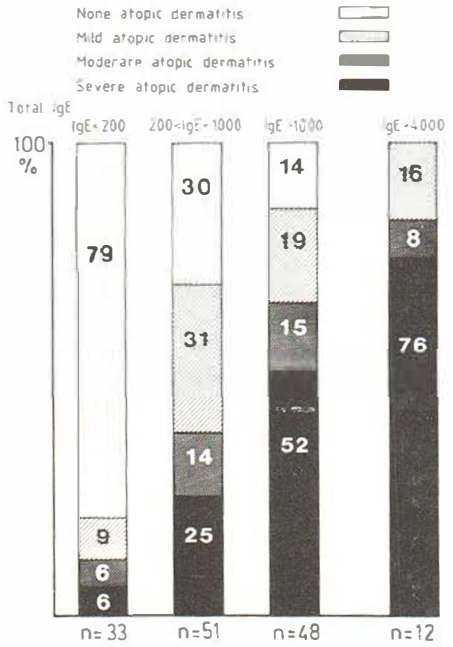

Fig. 1. Total IgE and degree of atopic dermatitis. The columns show the percentages in each group of atopic children with none, mild, moderate and severe atopic dermatitis. The groups are divided according to the level of total IgE in serum. The 12 patients, represented by the column on the right, are also included in the group with IgE >1000 U/ml. The gradation of atopic dermatitis was carried out according to (10).

tolerant group. These two groups were matched in total IgE levels, the mean values being 745 U/ml in the former and 730 U/ml in the latter (10).

The relationship between total IgE in serum and degree of atopic dermatitis was studied in 132 children, including egg-allergic as well as egg-tolerant children. These children were divided into three groups according to their levels of total IgE in serum. The degree of atopic dermatitis was recorded in each individual (10).

RESULTS

CIE of hen's egg white demonstrated 24 immunoprecipitates (6). In CRIE, thirteen of these proteins were shown to bind IgE-antibodies in one or more of the sera from the egg-allergic children. Three of these proteins were classified as major allergens, according to certain criteria (11). These proteins were purified and identified as ovalbumin, ovomucoid and ovotransferrin (7, 8).

Pruritus and exacerbation of atopic dermatitis were the symptoms of egg allergy most

Table 1. *Comparison between the egg-allergic and the atopic control group*

	Egg allergic patients (%)	Atopic control group (%)	*p*-values
Total IgE >1 000 U/ml	49	8	<0.001
Severe atopic dermatitis	47	10	<0.001
Severe bronchial asthma	41	23	0.03
Allergic rhinitis	76	49	<0.001
Allergy to cow's milk	17	1.5	<0.001
Allergy to fish	17	3	<0.001

frequently recorded (48%), whereas urticaria and asthma were recorded in 26% of the patients. Other symptoms observed were vomiting, angio-oedema, rhinitis, conjunctivitis and laryngeal oedema. 17% of the patients also reacted to inhalation of egg or egg-products, for instance in the kitchen when food containing eggs was prepared (10). Table I shows results from the comparison between the egg-allergic and the atopic control group. It is clearly demonstrated that the two groups are widely different in all parameters studied. The study of subgroups matched in serum IgE-levels, revealed that egg-allergic and egg-tolerant atopic children were very similar with respect to complaints from atopic diseases, atopic dermatitis included. The severity of atopic dermatitis in the groups differing in total IgE-level is shown in Fig. 1. This group demonstrates a clear correlation between level of total IgE in serum and the severity of atopic dermatitis.

DISCUSSION

The difference found between the egg-allergic and the atopic control group, are probably not due to the egg-allergy itself; egg was carefully eliminated from the diet of all the egg-allergic children. The study of the subgroups with similar IgE-levels, suggests that the differences between egg-allergic and egg-tolerant atopic children simply reflect that egg-allergic children tend to have higher levels of IgE in serum. The present study revealed a strong relationship between total IgE-level in serum and degree of atopic dermatitis.

Taken together with the observation that IgE-mediated reactions (such as egg-allergy) are able to provoke exacerbations of atopic dermatitis, it may be suggested that there is a causal relationship between IgE-mediated reactions and atopic dermatitis. Usually, however, atopic dermatitis cannot be successfully treated with elimination of foods suspected to cause allergic reactions. This observation indicates that food allergy is only one of several factors contributing to the pathogenesis of atopic dermatitis (5).

The present study of allergens in hen's egg white revealed that numerous proteins in the egg-white had caused IgE-antibody formation in the egg-allergic children. There were considerable individual variations in the patterns of egg-white specific IgE-antibodies. The various proteins seem to differ considerably in their ability to cause IgE-synthesis in atopics. Similar studies of individual allergens have been carried out with allergens such as pollens and moulds (12, 13). These studies indicate that a high number of proteins are capable of inducing IgE-synthesis, that is, act as allergens in predisposed individuals. But only a minor part of these allergens are probably strong enough to cause immediate type reactions.

Weak allergens may also contribute to mediator release if they combine with two membrane-bound IgE-molecules in the mast cell membrane (14). Provided there is a variety of such weak allergens and there is a persistent exposition to them, they may together cause a more or less continuous mast cell activation. The sum of mast cell derived mediators, including leukotriene, prostaglandins and chemotactic factors (15), may probably lead to inflammatory reactions, even if the mediator-release is low-graded.

This aspect of the IgE-mediated reaction may possibly be of clinical significance in the pathogenesis of atopic dermatitis, and should therefore be remembered in studies of the relationship between IgE-mediated reactions and atopic dermatitis.

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