Skin test reactivity to inhalant and food allergens in patients with allergic rhinitis

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Abstract

Allergic rhinitis is induced by an IgE-mediated inflammation after allergen exposure. An important component in the management of patients with allergic rhinitis is allergen avoidance. Allergen avoidance can help reduce disease severity and minimise treatment. The most common method of identifying provoking allergens is through a skin test. There is a wide range of allergens available for skin testing. In this study we determined the skin test reactivity to inhalant allergens and evaluated the role of food allergens in local patients with allergic rhinitis. Six hundred and seventy nine patients diagnosed as having allergic rhinitis were skin tested to 11 inhalant and 12 food allergens. Most of the subjects (94.0%), skin tested positive to at least one inhalant allergen. Three hundred and eighty-four (56.5%) patients had positive skin test to at least one inhalant and one food allergen. The most common allergens were *Dermatophagoides pteronyssinus* (87.6%), *Dermatophagoides farinae* (86.0%), cat fur (49.6%), cockroach (31.2%), shrimp (44.2%) and crab (25.8%). Although pollen and fungi are commonly implicated in other studies, only a small percentage of our patients had positive skin test to these allergens. The selection of appropriate allergens for skin testing local patients with allergic rhinitis should include the above common allergens. Additional allergens should be added to the panel based on the patient's history and exposure.

Key words: allergic rhinitis, skin testing, allergens

Introduction

Allergic rhinitis is a global health problem affecting 10% to 25% of the population (ARIA workshop report, 2001). Allergic rhinitis is induced by an IgE-mediated inflammation after allergen exposure. Allergic rhinitis is frequently associated with and may play an important pathophysiologic role in otitis media, sinusitis and asthma (Leynaert *et al.*, 2000). It often occurs in patients with other allergic disease; 80% children presenting with asthma and 50% with atopic dermatitis also suffer from allergic rhinitis (Nimmagadda & Evans, 1999; Virant, 2000). It has also been demonstrated that there is a high frequency of food hypersensitivity in patients with allergic rhinitis (Ortega Cisneros *et al.*, 1997).

An important component in the management of patients with allergic rhinitis is allergen avoidance. Allergen avoidance can help reduce disease severity and minimise treatment (Howarth, 1998). The most common method of identifying provoking allergens is to conduct a skin test. Skin testing for IgE-mediated disease is acknowledged to be the most clinically acceptable technique in the assessment of allergic patients (Bernstein *et al.*, 1995). There is an enormous range of allergens available for use in skin testing. Bernstein *et al.* (1995) recommended the use of as many as 70 epicutaneous tests to inhalant allergens. It is necessary to define an appropriate panel of allergens for skin testing in each clinical setting. This selection should be based on patient's age, history, allergen exposure and geographical locale in which the patients resides (Esch, 2001) In patients with respiratory tract allergies, skin testing is usually conducted with a variety of inhalant allergen. Although food allergy has been implicated in rhinitis (Ferguson, 1997; Pastorello *et al*, 1985), it is rarely included in the panel of allergens for routine screening of these patients. Hence, the aim of this study is to ascertain the skin test reactivity to inhalant allergens and to evaluate the role of food allergens in local patients with allergic rhinitis.

Materials and Methods

Patients

Patients diagnosed as having allergic rhinitis by an otorhinolaryngologist were invited to participate in this study. Pregnant women and children under the age of 12 were excluded. The subjects were required to withhold antihistamines for at least 2 weeks prior to testing. The research protocol was reviewed and approved by the Ministry of Health Ethics Committee. Informed consent was obtained from the participants or guardians. Each subject was interviewed and a thorough history of allergy, in particular food allergy, asthma, allergic conjunctivitis and atopic dermatitis was obtained. They were asked about food-provoked symptoms such as pruritus, urticaria, angio-oedema, gastrointestinal, nasal or ocular symptoms. Patients with such symptoms were also asked to identify the offending food. Family history of allergy was also obtained.

Skin prick test and total IgE

The skin prick test was conducted using a panel of 23 allergens together with a negative (diluent) control and positive (histamine 1mg/ml) control from Bencard UK. The allergens include *Dermatophagoides pteronyssinus* (Dp), *Dermatophagoides farinae* (Df), cat fur, cockroach, mixed pollen, *Aspergillus fumigatus*, *Aspergillus niger*, *Neurospora sitophilia*, *Rhizopus nigericans*, *Cladosporium clado-sporioides*, *Alternaria alternata*, shrimp, mussel, crab, milk, chocolate, cheese, wheat, egg, rice, beef, banana and mixed nuts. The test was carried out on the volar aspect of the forearm using a sterile lancet (Microlance, Becton Dickinson). A different lancet was used for each test to prevent carryover of allergens. After 15 minutes, circumferences of all the resulting wheals were drawn and transferred using a transfer tape. A reaction is considered positive if the mean diameter of the wheal is at least 3mm larger than the negative control. Total IgE was measured using an enzyme linked immunosorbent assay for IgE (Vedalab, France) following the manufacturer's instructions.

Statistical analysis

The statistical package SPSS was used for data entry and statistical analysis. The chi-square and t tests were used where appropriate. To approximate a normal distribution, total IgE was analyzed after natural logarithmic transformation.

Results

Six hundred and seventy nine patients diagnosed as having allergic rhinitis participated in the study. Three hundred and sixty five (53.8%) were females and 314 (46.2%) were males. The mean age of the patients was 27.7 (range 13 - 77) years. They were of various ethnic groups; 326 (48.0%) Malays, 158 (23.3%) Chinese, 155 (22.8%) Indians and 40 (5.9%) others.

Fifty percent (342/679) of patients reported food-provoked reactions. The most common food-provoked symptom was pruritus in 214 (31.5%) patients. Other food-provoked symptoms were urticaria (54/679; 8.0%), angio-oedema (30/679; 4.4%) and gastrointestinal symptoms (50/679; 7.4%). Many patients had more than one symptom. In 134 (19.7%) patients, the symptoms of allergic rhinitis were triggered or made worse by a particular type of food. Of those with history of food-provoked symptoms the following foods were most commonly implicated: shellfish (225/342; 65.8%), chicken (24/342; 7.0%), squid (22/342; 6.4%), milk (12/342; 3.5%), fish (11/342; 3.2%), egg (10/342; 2.9%), banana (10/342; 2.9%) and beef (5/342; 1.5%). Besides allergic rhinitis, 66% of patients had history of at least one other type of allergy. One hundred and ninety-two (28.3%) patients had asthma, 117 (17.2%) atopic dermatitis, 95 (14%) drug allergy, and 47 (6.9%) allergic conjunctivitis. Four hundred and six (59.8%) patients had a family history of allergy.

Six hundred and sixty-six (98.1%) patients had a positive skin test to at least one of the 23 allergens tested. Thirty (4.4%) patients skin tested positive to only one allergen. A large number of patients (117/679 or 76.4%) tested positive to 3 or more allergens. Two hundred and twenty eight (33.6%) were positive to 5 or more allergens and 60 (8.8%) were positive to 7 or more allergens.

Most subjects (94.0%) skin tested positive to at least one inhalant allergen. Three hundred and eighty-four (56.5%) patients had positive skin test to at least one inhalant and one food allergen. Only 28 patients were skin test positive to food allergen alone. The skin test reactivity to inhalant and food allergens is given in Table 1. The most common inhalant allergens are house dust mites, cat fur and cockroach. The most common food allergens are shrimp and crab.

Table 1. Skin test results

INHALANT		FOOD	
Allergen	% patients with +ve skin test	Allergen	% patients with +ve skin test
D. pteronyssinus	87.6	Shrimp	44.2
D. farinae	86.0	Crab	25.8
Cat fur	49.6	Mussel	8.7
Cockroach	31.2	Cheese	4.9
Mixed pollen	8.2	Chocolate	4.4
N. sitophilia	7.6	Egg	4.0
A. alternata	5.0	Beef	3.8
R. nigericans	2.8	Mixed nuts	3.4
A. fumigatus	1.8	Banana	3.1
A. niger	1.3	Wheat	2.8
C. cladosporioides	1.2	Milk	2.4
		Rice	2.1

Out of the 342 subjects with reported history of adverse reaction to food, 279 had a positive skin test. Therefore subjects with a history of adverse reaction to food were more likely to have a positive skin test to food compared to those with no history of adverse reaction, and this was statistically significant ($p < 0.0001$). We found 18.6% of subjects with positive skin test but no history of food provoked reactions.

Thirty percent of patients were pet owners, cat being the commonest (54.6%) pet, followed by dog (38%), bird (6.8%), hamster (2.4%) and rabbit (1.5%). Forty nine percent of cat owners were skin test positive to cat epithelium.

Mean total IgE of the patients was 263.6 IU/ml. Subjects with a positive skin test had higher mean total IgE (276.1 IU/ml) than those with negative skin test (49.2IU/ml) and this was statistically significant ($p < 0.0001$). Mean total IgE was higher in patients with coexisting asthma compared to those without (307 IU/ml compared to 246.6 IU/ml, $p = 0.04$). Total serum IgE was significantly associated with the number of allergens the subjects were skin tested positive to. Subjects skin tested positive to 4 or more allergens had a mean IgE level of 302.7 IU/ml compared to 222.8 IU/ml of those tested positive to less than 4 allergens ($p = 0.002$).

Discussion

Skin prick testing is widely used as a primary tool for the diagnosis of IgE-mediated hypersensitivity. It has been used over the past century to determine the aetiology of allergic symptoms, guide the physician in recommending measures of allergen avoidance, and direct specific immunotherapy (Zacharisen, 2000). A wide range of allergens is available commercially for use in skin testing. Most allergists use a standard panel of allergens, the selection of which is based on regional data. We conducted this study to determine potentially and clinically relevant inhalant and food allergens that could be considered for inclusion in a panel to skin test patients with allergic rhinitis in this country.

It is generally accepted that aeroallergens or inhalants are the principal offenders. A large number of patients in this study had positive skin test to house dust mite, cockroach and cat epithelium and this is also found in similar studies worldwide (Galant *et al.*, 1998; Pumhirun *et al.*, 1997). Although pollen and fungi are commonly implicated in temperate regions, only a small percentage of our patients had positive skin test to these allergens. It is possible that the commercial extracts used in this study did not contain the relevant allergen for this region. Interestingly, a similar study conducted in Singapore by Allumoorti *et al.* (1996) also found low skin test positivity to pollen and mould allergens amongst their local patients.

Although respiratory symptoms can occur after ingestion of food it is seldom indicated in the panel of allergen used for skin testing. Prior to this study, there was no local data to indicate if patients with allergic rhinitis would benefit from routine performance of food skin test. We found that more than 60% of our patients had positive skin test to food and most of them gave a history of food-provoked reactions. Food allergy can coexist with allergic rhinitis. Ortega Cisneros *et al.* (1997) found that in patients with allergic rhinoconjunctivitis, 20% were skin test positive to food, 50% to inhalants and 30% to both. Fiorini et *al.* (1990) in their evaluation of 78 subjects with respiratory allergies found that manifestations of respiratory allergies were worse in subjects with food-specific IgE.

We found 19% of subjects with positive skin prick test to food did not have a history of food allergy. This is not surprising as not all individuals with positive skin test will show signs and symptoms of clinical disease. It has been suggested that a positive skin test could indicate 'latent' allergy which might appear years later (Howarth, 1998; Hagy & Settipane, 1971).

A large number of our patients that reported symptoms with ingestion of seafood also had positive skin test to the allergen. This is not surprising as seafood is widely consumed by the population. IgE-mediated reactions to seafood,

particularly fish and crustacea, are among the most commonly encountered food allergens (Hebling *et al.*, 1996; Metcalf, 1984). This is particularly so where seafood is a major component of the diet (Dannaeus *et al.*, 1977; Bindslev-Jensen, 1998).

It is generally accepted that ingested food allergens rarely produce isolated IgE-mediated rhinitis without the involvement of other organ systems. In this study, we found pruritus, urticaria, facial and lip swelling, and gastrointestinal symptoms were common complaints among patients with food-provoked symptoms.

Measurement of total IgE is generally believed to be not effective for detecting allergies, since significant allergies can exist with normal total IgE levels. In addition, elevated IgE levels reflect not only significant allergies, but also possible parasitic infestations (Ferguson, 1997). We found that subjects with positive skin test had a higher mean total IgE than those with negative skin test. Subjects with coexisting asthma had a higher mean total IgE than those without. This probably reflects a greater severity of allergy. However, a number of subjects with positive skin tests did not have raised IgE levels and the value of total IgE remains limited and skin testing is still more reliable.

In conclusion, the selection of appropriate allergens for skin testing local patients with allergic rhinitis should include common inhalant allergens such as the house dust mite, cat fur and cockroach. Additional allergens should be added to the panel based on the patient's history and exposure. Evaluation of food allergy should be considered in patients with history suggestive of food allergy. Shellfish, fish and crustacea, consumed locally, should be included in the food panel. Skin testing if conducted properly using the most relevant allergens for the locality will be informative and will assist in patient management.

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