ORIGINAL ARTICLE

The skin prick test results of 977 patients suffering from chronic rhinitis in Hong Kong

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Objectives To evaluate the prevalence of aetiological allergens identifiable by skin prick test alone in patients suffering from chronic rhinitis in Hong Kong, and also compare the clinical history and symptoms of skin prick test–positive versus skin prick test–negative patients.

Design Prospective study.

Setting Otorhinolaryngology clinic in Queen Mary Hospital of Hong Kong.

Patients A total of 977 patients suffering from chronic rhinitis were recruited into the study. Skin prick test was performed with a panel of allergens including house dust mites, cockroach, cat, dog, moulds, and pollens.

Main outcome measures Skin prick test results and their correlation with symptoms.

Results Of the 977 patients, 651 (67%) had positive skin prick test reactions. The commonest allergen was house dust mite which was positive in 63% of the 977 patients and 95% of those 651 skin prick test–positive patients. The other allergens were in order of cockroach (23%), cat (14%), dog (5%), pollen (4%), and mould (3%). Compared with skin prick test–negative patients, skin prick test–positive patients were more likely to have earlier age of onset of the chronic rhinitis, association with asthma, more severe symptom in the morning, more severe symptoms of itchy nose, sneezing, nasal discharge, itchy eye, and watery eye.

Conclusions Identifiable aeroallergens could be detected in 67% chronic rhinitis patients by skin prick test alone. House dust mites were the most prevalent causative allergen. There were significant differences of patterns of clinical history and symptoms severity between skin prick test–positive and skin prick test–negative patients.

Introduction

Allergic rhinitis has characteristic symptoms of watery nasal discharge, sneezing, itchy nose, and stuffy nose. It is due to allergic reaction to aeroallergens including dust mites, pollens, animal danders, and moulds. Similar symptoms can be due to non-allergic rhinitis which consists of a group of rhinitis due to diversities of causes and the diagnosis is usually based on either identification of known non-allergic causes or by exclusion of allergy. Chronic rhinitis is common worldwide and according to epidemiological studies (including a few from Hong Kong) it is estimated to affect 10 to 40% of the population.[1-11] However, most of these epidemiologic surveys including those from Hong Kong were based on questionnaires without further clinical nasal examination and allergic tests to establish allergic rhinitis as the cause of symptoms. Due to such limitations of methodology, the true incidence of allergic rhinitis derived from many of these studies may be overestimates. Questionnaires alone cannot reliably distinguish between the various nasal diseases giving rise to similar symptoms.

Allergic rhinitis is due to immunoglobulin E (IgE)–mediated allergic reactions to aeroallergen. The management algorithm of allergic rhinitis is dependent on the identification of the aetiologic allergen and symptom severity. The types of aeroallergens, however, differ widely depending on localities.[1,2] In Hong Kong there may have been significant recent changes in the incidence and possibly pattern of causative allergens in association with rapid changes of city environments and population characteristics. However, up-to-date local data on the pattern of offending aeroallergens giving rise to allergic rhinitis are scarce. The present study therefore

Key words
Allergens; Rhinitis, allergic, perennial

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香港977位慢性鼻炎患者的過敏原皮膚點刺測試結果

目的 對香港慢性鼻炎患者施行皮膚點刺測試，從而評估所確定的各種致病過敏原的流行概況，並比較對皮膚點刺測試分別呈陽性和陰性反應患者的病史和症狀。

設計 前瞻性研究。

安排 香港瑪麗醫院耳鼻喉科。

患者 本研究共邀得977位慢性鼻炎患者接受皮膚點刺測試，測試他們對屋塵蟎、蟑螂、貓、狗、霉菌和花粉等一組有代表性的過敏原的反應。

主要結果測量 皮膚點刺測試以及與各種症狀的相關程度。

結果 在977位患者中，有651位(67%)對皮膚點刺測試呈陽性反應。最多患者呈陽性反應的過敏原是屋塵蟎，在977位患者中有63%，在651位對皮膚點刺測試呈陽性反應的患者中更高達95%，對其他過敏原的反應依次為蟑螂(23%)、貓(14%)、狗(5%)、花粉(4%)和霉菌(3%)。相比對皮膚點刺測試呈陰性反應的患者，對皮膚點刺測試呈陽性反應的患者開始患慢性鼻炎的年齡比較輕，更容易兼發哮喘，早上的症狀比較嚴重，同時鼻癢、打噴嚏、鼻涕、眼睛癢和淚水多這些症狀也比較嚴重。

結論 單靠皮膚點刺測試，已可在67%的慢性鼻炎患者中發現可識別的過敏原，其中屋塵蟎是最普遍的致病過敏原，而對皮膚點刺測試呈陽性或陰性反應的患者，他們的病史和症狀都有顯著的差異。

aimed at addressing the following questions: (1) What are the aeroallergens identifiable by skin prick test (SPT) that give rise to chronic rhinitis in Hong Kong? (2) Are there differences in symptom severity and medical history between such patients who are SPT-positive versus SPT-negative?

Methods

Data were prospectively collected from 977 consecutive patients who had SPTs to identify aeroallergens for chronic rhinitis in the Department of Otorhinolaryngology, Queen Mary Hospital over the period January 1999 to December 2004 inclusive. The term chronic rhinitis referred to patients who had been assessed by otorhinolaryngologists for a minimum of 1 year to establish the diagnosis and exclude other identifiable causes by virtue of their clinical history and physical examination (including nasoendoscopy). Patients with chronic sinusitis or other infective causes for the chronic rhinitis were excluded. Patients with similar nasal symptoms due to atrophic rhinitis, nasal polyposis, nasal tumours, or other known causes of non-allergic rhinitis including occupational rhinitis, aspirin sensitivity, endocrine disease, pregnancy, and drug-induced rhinitis were all excluded. The remainder (445 [46%] male and 532 [54%] female patients) had a provisional diagnosis of allergic rhinitis or vasomotor rhinitis and underwent further workup to confirm or rule out allergic cause. Their mean age was 34 (median, 33; range, 6-79) years. The mean duration of their chronic rhinitis symptoms was 12 (median, 10; range, 1-51) years.

For at least 2 weeks, no patients were taking medications (antihistamines, steroids, and other drugs) considered liable to affect the skin prick testing. Patients who had active skin disorders or dermatographia were considered not suitable for SPTs. The tests were performed according to standard methods with allergens, histamine-positive and -negative controls purchased from ALK-Abello (Denmark). The skin prick reaction was read at 15 minutes and considered positive when the reaction wheal diameter was at least 3 mm larger than the negative control. All patients had allergen testing for dust mites *Dermatophagoides farinae* (DF), *Dermatophagoides pteronyssinus* (DP), cockroach, cat, dog, and mould mix (containing a mixture of *Aspergillus amstelodami*, *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus terreus*, *Penicillium brevicompactum*, *Penicillium expansum*, *Penicillium notatum*, *Penicillium roqueforti*, Alternaria, Chaetomium, *Cladosporium fulvum*). This routine panel of allergens remained the same throughout the years. In the initial stages of our study, we also tested for many other potential allergens, including: pollen mix (containing a mixture of Avena, Hordeum, Triticum, Dactylis, Festuca, Lolium, Phleum, Poa, *Cynodon dactylon*, *Phragmites communis*), Aspergillus mix (containing *Aspergillus amstelodami*, *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus terreus*), *Blomia tropicalis* (BT), *Cynodon dactylon* (Bermuda grass), and house dust mite. In view of the infrequent positive reactions to these minor allergens, these allergens were not included in our routine panel in recent years, unless there was suspicious clinical history. The medical history and visual analogue symptom scores of these patients were also evaluated (on a scale of 0-6; 0=no symptom, and 6=maximum severity).

The statistics were performed by using Statistical Package for the Social Sciences (Windows version 13; SPSS Inc, Chicago [IL], US). Chi squared and *t* tests were performed as appropriate.

Results

The results of the SPTs are shown in Table 1. Of the 977 patients, 650 (67%) patients had positive reactions to at least one allergen among the five aeroallergens in our routine panel (dust mite, cockroach, cat, dog, and mould). In 546 patients, SPTs using pollen mix were performed; 21 (4%) were positive. Of these 21 patients, 20 (95%) were positive for at least one of the routine checklist aeroallergens and only one was sensitive to pollen alone. Overall, 651 (67%) of the patients had positive reactions to an allergen in at least one of these

TABLE 1. Results of skin prick tests

Allergen*	No. of patients	Positive reaction	Net wheal size, mean (median, range) in mm†
Dust mite (DF, DP, BT)	977	620 (63%)	-
DF and DP	977	613 (63%)	9.9 (9.0, 3-37)
BT	364	141 (39%)	5.0 (4.0, 3-20)
Cockroach	977	223 (23%)	4.5 (4.0, 3-10)
Cat	977	138 (14%)	5.7 (5.0, 3-23)
Dog	977	50 (5%)	4.0 (3.8, 3-12)
Mould mix	977	30 (3%)	4.6 (4.3, 3-7)
Aspergillus mix	591	29 (5%)	4.1 (3.3, 3-11)
Pollen mix	546	21 (4%)	4.4 (4.0, 3-12)
Bermuda grass	537	9 (2%)	4.3 (4.0, 3-11)
At least 1 of the 6 groups of allergens	977	651 (67%)	-

* **DF denotes *Dermatophagoides farinae*, DP *Dermatophagoides pteronyssinus*, and BT *Blomia tropicalis***
† **Net wheal size in mm = allergen reaction size – negative control size**
Negative-control wheal size: mean, 0.38 mm; median, 0 mm; range, 0-5 mm

TABLE 2. Comparison of symptoms severity and medical history of skin prick test (SPT)–positive and SPT-negative patients

Symptom severity/medical history	SPT-positive	SPT-negative	P value
Mean age of onset of symptoms (years)*	30.7	40.1	<0.005
Medical history of eczema†	35%	27%	0.038
Medical history of asthma†	24%	8%	<0.005
Medical history of drug allergy†	12%	11%	0.737
Family history of allergy†	71%	71%	0.323
Mean symptom scores‡			
Symptom severity in spring	4.0	3.7	0.167
Symptom severity in summer	4.0	3.4	0.423
Symptom severity in autumn	4.4	3.6	0.258
Symptom severity in winter	4.9	4.1	0.241
Symptom severity in morning	4.8	4.2	<0.005
Symptom severity in noon	2.9	2.7	0.174
Symptom severity in evening	4.0	3.8	0.237
Running nose	4.1	3.5	0.005
Postnasal drip	3.2	3.2	0.985
Itchy nose	3.6	3.0	<0.005
Sneezing	4.1	3.5	0.005
Stuffy nose	4.0	3.8	0.113
Hyposmia	2.2	2.2	0.140
Watery eye	2.2	1.6	<0.005
Itchy eye	2.5	1.9	<0.005
Headache	2.4	2.3	0.393

* **Independent *t* test was used for analysis of correlation of SPT result with age and symptoms**
† **Chi squared test was used for analysis of correlation of SPT result with medical and family history**
‡ **Symptom severity was assessed by visual analogue scale 0-6 (0=no symptom, 6=maximum severity)**

six groups of aeroallergens (house dust mite, cockroach, cat, dog, mould, and pollen).

On the 326 patients who tested negative to allergens from all six aeroallergen groups, SPTs were performed using house dust extract, to which four (0.4%) yielded positive reactions. Thus, a total of 655 (67%) of the patients had at least one positive SPT.

Of all the 651 patients with known reactions to

the routine panel aeroallergens or pollen mix, 620 (95%) were sensitive to house dust mites of whom 99% tested positive to DF and/or DP. Although 39% of the patients were sensitive to BT, only 1% dust mite–sensitive patients were sensitive to BT alone, but not the DP and DF.

Regarding the same 651 patients, 318 (49%) tested positive to multiple allergens including 221 (34%) to two allergens, 83 (13%) to three allergens, 12 (2%) to four allergens, 2 (0.3%) to five allergens. Of the 333 (51%) patients who were sensitive to a single allergen, the distribution of positivity was 306 (92%) to dust mite, 9 (3%) to cockroach, 7 (2%) to cat, 1 (0.3%) to dog, 9 (3%) to mould, and 1 (0.3%) to pollen.

The medical history and symptom severity of SPT-positive and negative patients are compared in Table 2. Skin prick test–positive patients had earlier age of symptom onset and were more likely to have a history of asthma and eczema. Both patient groups had more severe symptoms in the morning than at noon, but SPT-positive patients had more severe symptoms in the morning compared to those who were SPT-negative. The SPT-positive patients had more severe symptoms associated with itchiness (including itchy nose), sneezing, itchy eye, running nose, and watery eye.

Discussion

The symptoms of allergic rhinitis are nasal discharge, sneezing, itchy and stuffy nose. Other nasal diseases including chronic sinusitis, nasal polyposis, atrophic rhinitis, deviated nasal septum, nasal tumours, occupational rhinitis, aspirin sensitivity, endocrine disease, pregnancy, and drug-induced rhinitis can give rise to similar symptoms. The latter non-allergic nasal diseases should be ruled out by careful history taking and nasal examination, including nasoendoscopy. In the remaining patients with chronic rhinitis, the differential diagnosis is either allergic or vasomotor rhinitis. The diagnosis of allergic rhinitis can only be made after investigations to confirm the presence of an allergic reaction. The SPT is the recommended initial investigation for this purpose.[1]

We have shown that 67% of our patients suffering from chronic rhinitis in Hong Kong reacted to aeroallergens identifiable by SPT alone. Of those patients who had no identifiable aeroallergens, they had been clinically classified as 'non-allergic rhinitis'. Thus, the clinical term 'non-allergic rhinitis' should be interpreted cautiously to mean patients without identifiable allergen rather than non-allergic in aetiology. Similarly, SPT-negative patients are often labelled as having vasomotor rhinitis. This term may be a misnomer, which literally means a different pathophysiological cause of symptoms (not related to IgE-mediated allergy). For SPT-negative patients, since a presumed 'vasomotor' aetiology cannot be tested for, it seems preferable to substitute the label 'idiopathic rhinitis' (meaning aetiology not yet identified) in place of 'vasomotor rhinitis'.[1] In this paper, we therefore use the terms idiopathic rhinitis and SPT-negative rhinitis interchangeably to mean chronic rhinitis with negative SPTs.

These idiopathic rhinitis patients with negative SPTs might nevertheless be suffering from allergic causes not detected by the SPTs used. One possible reason could relate to intrinsic limitations of the SPTs themselves (depending on the available allergens and their specificity and affinity for the circulating IgE).[12] Moreover, SPTs may not identify patients with low-level IgE hypersensitivity reactions (triggering smaller than 3-mm size wheals). However, when we evaluated the present data using a less stringent definition of a positive reaction (2-mm wheals), there was only a 1% increase in the positive reaction rate (details are not shown in the results). A much higher dose of allergen is required in patients with low level of allergy to trigger the skin reaction, but such doses cannot be delivered by the SPT method and require recourse to intradermal injections. However, higher dose injections must be traded off against the lower specificity. Serial dilution tests have also been proposed as a means of circumventing problems associated with intradermal injections. Another reason for a false negative SPT may be that the patient is allergic to a rare aeroallergen (not included in our panel for testing). Although we tried to use a house dust extract containing multiple aeroallergens to screen patients reacting negatively to the common aeroallergens, only a few (<1%) reacted to the non-specific house dust mix. Despite these limitations, SPT is still the commonest means of identifying the aeroallergens responsible for allergic rhinitis. Alternative diagnostic tests entail determination of allergen-specific serum IgE levels and nasal challenge test. These two tests are much more time consuming and expensive than SPTs and have limited value in daily practice within public hospitals in Hong Kong. Internationally, SPTs continue to be the most acceptable and cost-effective means of diagnosing allergic rhinitis, and were recommended as such in the position paper of the European Academy of Allergology and Clinical Immunology.[1]

The most common aeroallergen in Hong Kong is the house dust mite. Of all SPT-positive allergic rhinitis patients, 95% were sensitive to one or more species of house dust mites. *Blomia tropicalis*, which is commonly found in tropical regions, is also found locally.[13-16] However, it is rare to encounter patients with sensitivity to BT alone and not to DP and/or DF. This ensued in only 1% of our patients and is therefore different from the findings encountered in other tropical countries in south Asia and elsewhere (BT alone occurs in 12% of Singaporean and Venezuelan patients).[13,14] Nevertheless, BT should always be included as a routine SPT allergen in these tropical countries. Using a mixture of DP and DF, the allergen was picked up in 99% of Hong Kong patients with dust mite allergy. A working protocol in our hospital involves initial screening with a DP/DF mix, and

BT testing only if the patient tests negative to this mix. In Hong Kong, sensitivity to other allergens was usually additional to house dust mite allergy. Only 5% of allergic patients were exclusively sensitive to allergens other than the house dust mite. Multiple causative allergens were found in about 50% of local patients, which could be an important consideration for allergen avoidance and desensitisation therapy.

The patterns of aeroallergens in the environment differ widely in different localities and seasonal changes (particularly when they affect pollen) are also important. Hong Kong is a city in which some urban areas are full of densely packed tall buildings with relatively few trees and meager amounts of grass. However tree and grass pollens are blown in the air by the wind, and can travel for miles (together with other dust particles) across the border from nearby cities of southern China. Despite these potential sources of tree and grass allergenic pollens, such allergy was not an important contributor to chronic rhinitis in Hong Kong. Even in the 5% of patients who had pollen allergy, most (99%) had other indoor aetiologic allergens to account for their symptoms. Only one patient had pure pollen allergy; the sensitivity being to the golf course grass *Cynodon dactylon* (Bermuda grass). Cockroach, cat, and dog allergens affected significant percentages of our Hong Kong patients, the majority of whom also had dust mite allergy. Although only 11 cat-allergic and five dog-allergic patients had pets at home or in their working place, relatively large numbers had positive skin prick reaction. This observation is consistent with the well-known fact that animal danders are brought into homes from other places by clothes and remain for prolonged periods. Many of our patients might also have developed the cat or dog animal allergy in the past, although the current symptoms were due to other concomitant allergens, particularly house dust mite. Mould allergy, particularly aspergillus, also contributes to allergic rhinitis in the hot and humid environment of Hong Kong.

Both SPT-positive and -negative rhinitis patients had perennial symptoms over many years; none had a seasonal rhinitis pattern. For patients testing SPT-positive, corresponding allergens were all perennial. The perennial symptoms of the only patient with pure pollen allergy, were entirely consistent with the perennial nature of golf course grass.

Skin prick test–positive patients were more likely to have earlier age of onset of the disease. They were also more likely to be associated with asthma and eczema, and severe running nose and watery eyes. It is well-documented that allergic rhinitis is closely related to asthma; both conditions together are often considered to be a single disease affecting the whole respiratory tract.[2] Skin prick test–negative patients can be regarded as either having low-level IgE–mediated allergic rhinitis (below reaction threshold of the SPT) or due to non-IgE–mediated pathophysiologic causes. Such patients had weaker IgE-mediated skin reactions than SPT-positive patients. The extent of reaction in the skin also reflected the degree of IgE-mediated allergic reactivity in other body organs including the nose and eye, which might account for the difference in symptom severity between SPT-positive and -negative patients. Irrespective of underlying aetiology, SPT-negative patients were older at the time of disease onset, were less likely to have asthma and eczema and symptoms in the morning. They were also less liable to have running and itchy noses, watery and itchy eyes, and sneezing.

In conclusion, 67% of chronic rhinitis patients in Hong Kong had identifiable aeroallergens detected by SPTs alone. The most common aetiologic allergen was house dust mite (including DF, DP, and BT). Cockroach and cat were also common allergens, whereas dog, mould, and pollen were uncommon. Multiple allergens were found in about half of SPT-positive patients. Skin prick test–positive patients were more likely to have earlier age of onset of symptoms, higher chance of association with asthma, more severe symptoms in the morning, more severe itchiness of the nose and eyes, more severe running nose and watery eyes. This information may be useful to clinicians managing patients suffering from chronic rhinitis.

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