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Evaluation of the relationship between cockroach sensitivity and house-dust-mite sensitivity in Turkish asthmatic patients

Azize Üzel[a], Nermin Çapan[a], Sema Canbakan[a], Ahmet Selim Yurdakul[b,*], Berna Dursun[a]

[a]*Atatürk Chest Disease and Thoracic Surgery Education and Research Hospital, Ankara, Turkey*
[b]*Department of Pulmonary Medicine, Gazi University School of Medicine, Ankara, Turkey*

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Summary Exposure to cockroach has been identified as an important source of indoor allergens in patients with asthma and allergic rhinitis.

We evaluated the relationship between cockroach sensitivity and other allergens in patients with asthma. A total of 114 patients, defined asthma according to GINA, were enrolled in this study. A questionnaire including age, sex, duration of asthma, history of cockroach presence at home, and total IgE, blood eosinophil count, pulmonary function tests, standard skin prick test additional cockroach and shrimp allergen were performed.

There were 84 (73.7%) female and 30 (26.3%) male patients with a mean age of 38.1+10.1 years. The average duration of asthma was 7.7+7.2 years. Sixty five (57%) patients were determined atopic and 49 (43%) nonatopic. Polen allergen was the most common allergen in 59 (51.8%) patients with asthma, and second common allergen was mite allergen in 43 (37.7%) patients. Cockroach sensitivity were detected in 23 (20.2%) of 114 all asthmatics and 23 (35%) of atopic asthmatics. High rates of house-dust-mite allergy (73.9%) was determined in patients with cockroach sensitivity ($P<0.05$), while we found no relationship with other allergens. There was no difference for cockroach sensitivity between rural and urban population. Cockroach sensitivity was more common in mild bronchial asthmatics and a female predominance was observed. In addition, there was no association between shrimp and cockroach sensitivity.

As a result, a high rate of cockroach sensitivity alone or with mite sensitivity was seen in patients with bronchial asthma in Turkish population. Because of cross-reactivity between mites and cockroach, cockroach sensitivity should be

*Corresponding author. Faculty of Medicine, Department of Chest Diseases and Tuberculosis, Gazi University, Bucak Street, No. 31/7, Ankara, Turkey. Tel.: +90 312 3648187; fax: +90 312 3552110.
E-mail address: ahmetselimyurdakul@hotmail.com (A.S. Yurdakul).

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investigated in patients with house-dust-mite allergy. In addition, a high rate of cockroach sensitivity, in terms of IgE sensitization, may be important for the development of new sensitizations.

Introduction

Allergic response to aeroallergens is considered as an important factor in the asthmatic process and life style of modern world is likely to be associated with increases in its prevalence.

It has been reported that cockroach sensitivity is one of the most important indoor allergen sensitivities.[1] Cockroach allergen levels are correlated with severity of asthma and increases in its morbidity.[2] Tropomyosin is known to cause a cross reaction between house-dust-mite allergen and cockroach allergen. Tropomyosin is also present in shrimp.[3]

We aimed to investigate the rate of cockroach sensitivity and its coincidence with other aeroallergen sensitivities, comparison of serum IgE level, blood eosinophil count, severity of asthma, numbers of asthma attack in the preceding year in populations with/without cockroach sensitivity in Turkish asthmatic patients. In addition, we evaluated the relationship between cockroach sensitivity and shrimp.

Materials and methods

A hundred and fourteen patients, defined asthma according to GINA, admitted to our asthma outpatient clinic of education and research hospital between January and April 2003 were included in this study.[4] All of the patients were recruited consecutively. Only one patient refused to participate in the study.

Subjects under the age of 18, those who were pregnant, patients with COPD and congestive heart failure and patients on acute asthmatic attack were excluded from the study. All of the patients gave their written informed consent, having been informed about the details of the study. This study was conducted in accordance with the Declaration of Helsinki amended the 52nd WMA General Assembly (Edinburgh, 2000), and approved by local ethics committees.

We applied a questionnaire to the patients including age, sex, duration of illness, history of cockroach presence in their house, characteristic of environment they lived in and number of asthmatic attacks in the preceding year.

Pulmonary function tests

Spirometry was undertaken using a flow sensor spirometer (Sensormedics, Vmax 229, Yorba Linda-California) at morning for each subjects.

Measurements of serum total IgE level and blood eosinophil count

Venous blood samples were collected from patients after 8 h of fasting early in the morning. After centrifuging for 10 min at 3000 rpm serum samples were extracted. Tusah AIA—Pack Reagent in Eurogenetics-Tusah AIA-21 Automated Enzyme Immunoassay Analyser was used during the procedure. EIA (Enzyme Immunoassay) method was used for the measurements. Periferal blood eosinophil count was performed using standard hematologic techniques.

Bronchoprovocation test

Methacoline inhalation challenge test was performed with Devilbiss model 646 nebulizer according to the method described by ATS statement.[5]

Several bronchodilatator agents were withdrawn before challenge as recommended in ATS guideline. Patients were allowed to continue their inhaled steroids as usual. They were not allowed to drink coffee, cola drinks and to eat chocolate at least 6 h prior to challenge.

Skin prick tests

Allergy was evaluated by the presence of sensitization to the most common classes of aeroallergens by performing a skin prick test. The allergen panel consisted of the following: House dust mites (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*), mold mix, epithelia and feathers (cat and dog), grass mix, weed mix, cereals mix, trees mix and others (Cockroach—*Blatella germanica*, shrimp) (Stallergenes S.A, France). A histamine solution in distilled water (10 mg/ml) was used as the positive control and glycerol-buffered diluent of the allergen preparations as the negative control. Each patient was skin tested on the volar surface of forearm using prick lancets. The skin reaction was recorded after 15 min by evaluating

the skin response rate to the inoculation of each allergen extract compared with the wheal given by the positive and negative controls. A wheal diameter greater than or equal to 3 mm was considered positive reaction. Use of antihistamines was stopped a week before the skin prick test.

Statistical analysis

Data processing and statistical analysis were performed using SPSS windows package program. All data are presented as mean ± standard deviation. In assessing the results, Student's *t*-test, χ^2 test, two-way analysis of variance and Mann–Whitney *U*-test were used. A *P* value less than 0.05 was considered statistically significant.

Results

A total of 114 patients with asthma (84 (73.7%) female patients, 30 (26.3%) male patients) were enrolled in this study (Table 1). Fifty-four of them (47.4%) also had allergic rhinitis. Among the asthmatic patients, 30 (26.3%) were active, 38 (33.3%) were passive smokers. Fifty-seven (50%) patients were classified as mild, 42 (36.8%) moderate and 15 (13.2%) as severe asthma. Mean number of asthmatic attacks were 1.95 ± 2.2 per year.

Sixty-five (57%) of them had positive skin prick test reaction to at least one of the common aeroallerges. These patients were evaluated as atopic and the remaining 49 (43%) patients as nonatopic. Characteristics of the atopic and nonatopic patients as age, environmental background and duration of disease were given in Table 1.

Thirty-eight (58.5%) of atopic asthmatic and 16 (32.7%) nonatopic asthmatics had accompanying allergic rhinitis ($P<0.006$). There was no correlation between atopy and severity of asthma ($P>0.152$). In atopic asthmatics, mean serum total IgE level was found significantly higher than nonatopics, respectively (298.2 ± 307.6 IU/ml, 105.3 ± 166.9 IU/ml, $P<0.001$). There was no significant difference in blood eosinophil counts between atopic and nonatopic patients ($P>0.074$). When we compared the number of annual attacks, we could not find any difference between atopics and nonatopics ($P>0.52$).

Distribution of allergens of atopic patients were shown in Fig. 1. We detected cockroach sensitivity in 23 (35%) of 65 atopic patients. Of the patients with cockroach sensitivity, 19 (82.6%) were female and 4 (17.4%) were male. There was no significant difference between patients from rural (20%) and urban area (20.3%) for cockroach sensitivity.

Presence of insects in their home was higher in patients whom we detected cockroach sensitivity by skin prick test when compared to patients with negative skin prick test result, respectively (65.2%, 28.6%, $P<0.007$). In addition, history of presence of insects at home was higher in patients having asthma together with allergic rhinitis determined by positive skin prick test reaction to cockroach ($P<0.015$). When patients were evaluated according to asthma severity, there was no significant difference between severity of disease and presence or absence of cockroach sensitivity ($P>0.79$)(Table 2). And also, there was no relation between any sensitization and severity of asthma ($P>0.05$).

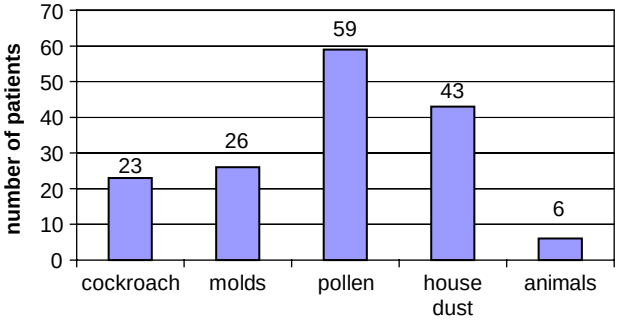

Figure 1 Distribution of allergen types.

Table 1 Demographic characteristics of the patients.

	Atopic	Nonatopic	Total
No. of patients	65	49	114
Age (years)	38.7 ± 8.6	37.3 ± 11.9	38.1 ± 10.1
District			
Urban	39	40	79
Rural	26	9	35
Mean duration of asthma (years)	7.7 ± 7.1	7.6 ± 7.4	7.7 ± 7.2
Mean duration of allergic rhinitis (years)	6.6 ± 6.7	3.8 ± 4.6	5.8 ± 6.2

Table 2 Comparison of subjects with and without cockroach sensitivity.

	Cockroach sensitivity (negative) n: 42	Cockroach sensitivity (positive) n: 23
Severity of asthma		
Mild	19 (45.2%)	11 (47.8%)
Moderate	16 (38.1%)	7 (30.5%)
Severe	7 (16.7%)	5 (21.7%)
Duration of asthma (years)	7.3±6.9	8.5±7.6
Number of attacks	2.1±2.6	2.2±2.2
Ig E level (IU/ml)	295.9±313.7	302.3±302.9
Methacoline challenge test (PC_{20}: mg/ml)	1.93±3.12	1.74±3.15
FEV_1	79.6±22.2	80.0±23.5

Table 3 Relationship between cockroach sensitivity and house dust mites.

	Mites (positive) n: 43/114	Mites (negative) n: 71/114	Total
Cockroach sensitivity (positive) n: 23/114	17/23 (73.9%)	6/23 (26.1%)	23/114 (20.2%)
Cockroach sensitivity (negative) n: 91/114	26/91 (28.6%)	65/91 (71.4%)	91/114 (79.8%)
Total	43/114 (37.7%)	71/114 (62.3%)	114 (100%)

Patients with cockroach sensitivity were compared to atopic patients without cockroach sensitivity in terms of duration of disease, number of acute attacks, total IgE level, and FEV_1. No significant difference was observed between two groups ($P>0.05$) (Table 2).

Among all the patients, we observed coexistence of asthma and allergic rhinitis in 41 (75.9%) of the cases those without cockroach sensitivity and in 13 (24.1%) of the cases those with cockroach sensitivity. When patients having asthma alone were compared in terms of these data, there was no significant difference between the groups ($P>0.32$).

Among all the asthmatics, in patients without cockroach sensitivity, we detected positive skin test reactivity to house dust mites in 26 (28.6%) cases. In patients with cockroach sensitivity, reactivity to house dust mites was observed in 17 (73.9%) patients. This result was found statistically significant ($P<0.001$)(Table 3).

In two patients, we detected cockroach sensitivity alone. Shrimp sensitivity was observed only in one case. In the patient whom we detected shrimp reactivity had also positive skin reaction to cockroach.

Discussion

Cockroach was noted as one of the most important allergen sources for the development of asthma and allergic rhinitis and one of the important causes of indoor allergens.[6,7] In various studies, it is suggested that increase in prevalence, morbidity and mortality of asthma could be originated from cockroach sensitivity.[8,9–12] Cockroach sensitivity is reported as 58% in USA, 6.3–29% in European countries, 30% in Africa, 30% India, while in Turkey, it is found as 9.5–36% in studies from different regions of the country.[8,13–16]

Among the cockroach species, *Blatella germanica* is known to have a high immunologic potency and is the most widely encountered one.[6] In Turkey, *Blatella germanica* is also one of the most frequently observed cockroach species and number of studies involving this sensitivity are growing up. Mungan et al. reported sensitivity to *Blatella germanica* in patients with asthma as 25.7% among all the cases, 41% among the atopics.[17] We also used *Blatella germanica* in the skin prick test panel, since it is one of the most frequently found cockroach species in Turkey. Cockroach sensitivity was detected in

20.2% of all asthmatics, and in 35% of atopic patients.

Cockroach sensitivity is commonly seen in young males and adult females, but the cause of this result is not clear yet.[18] Variability in distribution of age and gender may be related to different allergen exposure depending on the life style of the population groups. We detected cockroach sensitivity in 40% of females and 22% of males. Our study group having cockroach sensitivity had a mean age of 38.7 ± 7.5 years. There was no difference between the mean age of asthmatics having cockroach sensitivity and the general asthma population in our study.

Most appropriate therapy for the cockroach sensitivity is avoidance from cockroach allergen in the house dust. Cockroach sensitivity can be observed even without the evidence of cockroach infestation.[6] Cockroaches can be found not only at home but anywhere as school, offices and other living areas. In contrast to mites, cockroach sensitivity is also related to outdoor contacts, therefore taking preventive measures such as sampling of indoor sources (mat, mattress, etc.) could not be used as an evidence of cockroach sensitivity.[7] Eight patients had cockroach sensitivity, although no insect was detected in their houses in our study.

We also investigated the relationship between the cockroach allergen sensitivity and the other allergen sensitivities. Coexistence of cockroach and house-dust-mite allergen sensitivity is well known. In various studies, it is suggested that it may be due to cross reaction between the two allergens.[3,19,20] Allergen named as tropomyosin is accused as the origin of this cross reaction.[3,17]

Tropomyosin is also present in shrimp. We performed skin prick test including shrimp allergen to all of the study subjects. Only in one patient, we could detect cockroach and shrimp sensitivites together.

We detected 73.9% house-dust-mite allergy among all cockroach-sensitive patients. In previous studies, coincidence of cockroach and house-dust-mite allergy was reported as 26.8% in Calcutta and 70% in Ankara, respectively.[15,17] Linneberg et al. found that the incidence of sensitization to cat and dog was significantly associated with the presence of IgE sensitization to other allergens at baseline. They suggested that an immunologic predisposition seemed to be an important determinant of the development of new sensitization.[21] In addition, Bodtger et al. have shown that asymptomatic adults who were birch skin prick test-positive had an increased risk of developing allergy.[22] A high rate of coexistence of cockroach and mite sensitization may be associated with an immunologic predisposition, in terms of IgE sensitization.

It was reported that the characteristics of centre of population like urban, inner-city or rural did not influence cockroach sensitivity, but indoor characteristics were found most likely to affect cockroach sensitivity. In Kentucky, Garcia et al. detected cockroach sensitivity of 41% and 43% in urban and rural population, respectively.[6] Cockroach allergen level was found elevated in the houses of asthmatics with cockroach sensitivity in low-cost public housing in Strasbourg.[23] In our study, it was found 20.3% in urban and 20% in rural population. These results were not statistically significant and thought to be related to the life style of the patient and the type of the building the patient lived in.

Asthmatics with cockroach sensitivity had shown to have perennial and chronic symptoms and a more severe course of the disease. This could be explained by the long lasting exposure to indoor allergens.[18,24] We could not detect any significant increase in severity of the symptoms during a specific season of the year. It is thought that increase in symptoms were present throughout the year in equal severity.

When we evaluated the severity of asthma, most of our patients with cockroach sensitivity had mild asthma (48.8%) and the duration of disease was not significantly different in patients with sensitive to cockroach allergen than those of who were not.

Cockroach sensitivity in asthmatic population is mostly encountered in populations with low socioeconomical level and African–Americans.[10,11,25] Sampson et al. supported this view in a study including 87 moderate and severe asthmatic children (5–17 years) in Baltimore. In addition, poverty and poor dwelling conditions could increase cockroach infestation.[8] Cockroach sensitivity is known to be considerably higher in patients with low socioeconomical level. Unfortunately, we could not assess the socioeconomical status of our patients in our study. There was no difference in the frequency of emergency room admittance related to acute attacks experienced in the preceding year between the groups with and without cockroach sensitivity. Proper follow-up and treatment programme could be responsible from this result.

As a result, a high rate of cockroach sensitivity alone or with mite sensitivity was seen in patients with bronchial asthma in Turkish population. Because of cross-reactivity between mites and cockroach, cockroach sensitivity should be investigated in patients with house-dust-mite allergy. In addition, a high rate of cockroach sensitivity, in terms of IgE sensitization, may be important for the development of new sensitizations.

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