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Evaluation of Patients with Inhalant Allergen Sensitivity Detected by Skin Prick Test

Deri Prick Testinde İnhalen Allerjen Duyarlılığı Saptanan Hastaların Retrospektif Değerlendirilmesi

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Abstract

Objective: Atopy refers to an individual's predisposition to develop allergies. Allergens can cause asthma, allergic rhinitis (AR), and atopic dermatitis (AD). The allergy skin prick test (SPT) is a safe, easy-to-apply, and cost-effective diagnostic tool for detecting sensitivity to allergens. This study aims to evaluate the relationships between identified allergen sensitivities, age groups, presenting complaints, and clinical diagnoses in patients who underwent SPT.

Method: The results of 2413 patients who underwent SPT in University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital's Pediatric Allergy Unit between March 1, 2012, and February 28, 2014, were retrospectively evaluated.

Results: The ages of the cases ranged from 1.7 to 17.5 months, with a mean age of 7.76±2.93 years. Of the cases, 990 (41.03%) were female and 1423 (58.97%) were male. Asthma was diagnosed in 1064 patients, AR in 186 patients, and both asthma and AR in 1163 patients. Among the 2413 SPT results evaluated, 576 were negative, while at least one allergen sensitivity was detected in 1837 prick tests. The most common presenting complaint was cough in 2145 patients (88.93%), and the most frequent allergen sensitivity was against *Dermatophagoides pteronyssinus* at 57.4%. Thirty-nine patients had AD accompanying their existing diagnoses, with AD most commonly observed alongside AR at 6.5%.

Conclusion: Our study found that the most common allergen sensitivity was against house dust mites. Identifying sensitivity to aeroallergens via SPT and protecting patients from these allergens forms the cornerstone of treatment in children diagnosed with allergic diseases such as asthma, AR, and AD.

Keywords: Allergen sensitivity, allergic diseases, skin prick test

Öz

Amaç: Atopi, bir kişinin allerji gelişimine eğilimli olması halidir. Allerjenler; astım, allerjik rinit (AR) ve atopik dermatite (AD) neden olur. Allerji deri prik testi (DPT) allerjene karşı duyarlılığı saptamada güvenli, kolay uygulanabilir ve düşük maliyetli bir tanı aracıdır. Çalışmamızda DPT uygulanan hastaların saptanan allerjen duyarlılığı, yaş grupları, başvuru şikayetleri ve klinik tanıları arasındaki ilişkilerin değerlendirilmesi amaçlanmıştır.

Yöntem: Sağlık Bilimleri Üniversitesi, Bakırköy Dr. Sadi Konuk Eğitim ve Araştırma Hastanesi, Çocuk Alerji Polikliniği'nde 1 Mart 2012-28 Şubat 2014 tarihleri arasında DPT uygulanan 2413 hastanın sonuçları retrospektif olarak değerlendirilmiştir.

Bulgular: Çalışmaya alınan olguların yaşları 1,7 ile 17,5 yaş arasında değişmekte olup ortalama yaş 7,76±2,93 yıldır. Olguların 990'ı (%41,03) kız, 1423'ü (%58,97) erkektir. Hastaların 1064'üne astım, 186'sına AR ve 1163'üne astım+ AR tanısı konulmuştur. Değerlendirilen 2413 DPT sonucunun 576'sı negatif olarak sonuçlanmış, 1837 prik testinde en az bir allerjen duyarlılığı saptanmıştır. En sık başvuru şikayeti 2145 hastada (%88,93) öksürük olmuş, en sık allerjen duyarlılığı %57,4 ile *Dermatophagoides pteronyssinus*'a karşı saptanmıştır. Otuz dokuz hastanın mevcut tanılarına AD tanısı da eşlik etmiş olup AD %6,5 ile en sık AR ile beraber görülmüştür.

Sonuç: Çalışmamızda en sık alerjen duyarlılığı ev tozu akarlarına karşı saptanmıştır. Astım, AR ve AD gibi alerjik hastalık tanısı alan çocuklarda DPT ile aeroallerjenlere karşı duyarlılığın belirlenmesi ve hastaların allerjenlerden korunması tedavinin temelini oluşturmaktadır.

Anahtar kelimeler: Allerjen duyarlılığı, allerjik hastalıklar, deri prik testi

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Introduction

Atopy refers to an individual's predisposition to develop allergies due to their genetic characteristics. It is characterized by the tendency to produce IgE antibodies in response to low-dose allergens, usually proteins. These allergens cause asthma, allergic rhinitis (AR), and atopic dermatitis (AD), and according to the World Health Organization and World Allergy Organization, approximately 40% of the world's population is estimated to be atopic (1). The interaction of personal and environmental factors results in atopic diseases, with genetic predisposition being the most significant personal factor. Environmental factors include respiratory allergens, diet, infections, cigarette smoke, and air pollution (2).

Upon inhalation, skin contact, or oral ingestion of antigens, the body becomes sensitized due to the activation of mast cells and the production of vasoactive mediators in the tissues. When the sensitized body is exposed to the allergen a second time, vasodilation, increased vascular permeability, and mucus secretion occur. These mediators cause AR in the nasal mucosa, allergic asthma in the lungs, and urticaria on the skin. Diagnosing these diseases involves supporting the findings from the patient's history and physical examination with laboratory tests (3-5).

The skin prick test (SPT) is a widely used, easy, rapid, and reliable method for diagnosing allergies (6,7). A positive skin test indicates the presence of specific immunoglobulin (Ig) E on dermal mast cells (8). SPT is a crucial diagnostic tool for detecting allergen sensitivity due to its safety, relatively easy application, and low cost (9).

This study aims to evaluate the relationships between age groups, presenting complaints, identified allergen sensitivities, and clinical diagnoses in patients who underwent SPT in University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital's Pediatric Allergy Unit between March 2012 and February 2014.

Materials and Methods

This study included patients who were followed up with diagnoses of asthma, AR, and AD and underwent SPT in the Pediatric Allergy and Immunology Unit of University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital between March 2012 and February 2014. Skin prick tests were performed on all patients by a pediatric immunology and allergy specialist, and the results were evaluated by the same physician. Histamine (1.0 mg/mL) was used as a positive control, and standard saline was used as a negative control. All results were evaluated at the 20th minute, when the reaction was at its peak. If the largest diameter of the resulting induration was 3 mm or larger, the positive control was 3 mm or larger, and there was no reaction at the negative control application site, the prick test was considered positive. After obtaining ethical committee of University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital approval, the results of the skin prick tests conducted were retrospectively evaluated (approval date: 05.05.2014, decision number: 2014/07/33).

Statistical Analysis

Statistical analyses in this study were performed using NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA). In evaluating the data, descriptive statistical methods (mean, standard deviation) were used, as well as One-Way Analysis of Variance for comparisons between groups, independent t-test for comparisons between two groups, and chi-square and Fisher's exact tests for qualitative data comparisons. The results were evaluated at a significance level of $p<0.05$.

Results

The study included the prick test results of 2413 cases conducted between March 1, 2012, and February 28, 2014, at the Pediatric Allergy and Immunology Clinic of University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital. The ages of the cases ranged from 1.7 to 17.5 months, with a mean age of 7.76±2.93 months. Of the cases, 990 (41.03%) were female, and 1423 (58.97%) were male. The mean age for female cases is 7.77±2.88 years (2-16.66 years), while for male cases, the mean age is 7.76±2.97 years (1.75-17.53 years).

Examining the initial presenting complaints, cough was noted in 2145 patients (88.9%), wheezing in 938 patients (38.8%), and nasal symptoms in 1385 patients (57.4%). The occurrence of cough or wheezing as the initial complaint was significantly more common in patients with asthma and asthma+AR (p=0.0001). Nasal symptoms were more frequently observed as the presenting complaint in patients with AR and asthma+AR, also showing statistical significance (p=0.0001) (Table 1).

Among the 2413 evaluated SPT results, 576 were negative. The remaining 1837 tests revealed sensitivity to at least one allergen. In our study, house dust mites were the most frequently detected allergens, with a higher prevalence

in patients diagnosed with both asthma and AR, showing statistical significance ($p<0.05$). The distribution of allergen sensitivities by diagnosis is shown in Table 2.

In 39 patients who underwent SPT, AD was also present in addition to their existing diagnoses. Of these, 26 were male and 13 were female. Among asthmatic patients, 19 (1.8%) also had AD. Among AR patients, 12 (6.5%) had AD, and among those with both asthma and AR, 8 (0.7%) had AD.

In the evaluation of patients with positive allergen sensitivity according to their symptoms, the most common presenting complaint was cough, followed by nasal symptoms. Wheezing was found at a higher rate in patients with cat and dog epithelium sensitivity compared to other allergen sensitivities. The distribution of symptoms according to allergen sensitivities is presented in Table 3.

Table 1. Distribution of initial presenting complaints according to diagnoses

Initial complaint	Asthma (n, %)	AR (n, %)	Asthma + AR (n, %)	p
Cough	978 (91.9%)	107 (57.5%)	1060 (91.2%)	0.0001[a]
Wheezing	439 (41.2%)	19 (10.2%)	480 (41.3%)	0.0001[a]
Nasal symptoms	404 (37.9%)	150 (80.6%)	831 (71.5%)	0.0001[a]

[a]: Chi-square test, AR: Allergic rhinitis

Table 2. Distribution of allergen sensitivities according to diagnoses in patients undergoing skin prick tests (%)

Allergen	Asthma (n, %)	AR (n, %)	Asthma + AR (n, %)	p	AD (n, %)	p	Total (n, %)
Dermatophagoides farinae	554 (52.07)	88 (47.31)	740 (63.63)	**0.0001[a]**	19 (48.72)	0.277	1401 (58.06)
Dermatophagoides pteronyssinus	560 (52.63)	89 (47.85)	738 (63.46)	**0.0001[a]**	20 (51.28)	0.431	1407 (58.30)
Grass pollens	455 (42.76)	80 (43.01)	650 (55.89)	**0.0001[a]**	16 (41.03)	0.307	1201 (49.77)
Trees-1 (early flowering)	394 (37.03)	69 (37.10)	520 (44.71)	**0.001**	18 (46.15)	0.486	1001 (41.48)
Trees-2 (mid-season flowering)	267 (25.09)	38 (20.43)	365 (31.38)	**0.0001[a]**	4 (10.26)	**0.014[b]**	674 (27.93)
Weed pollens	181 (17.01)	21 (11.29)	229 (19.69)	**0.013**	7 (17.95)	0.990	438 (18.15)
Grass and cereal pollens	146 (13.73)	23 (12.37)	196 (16.85)	0.067	3 (7.69)	0.191	368 (15.25)
Molds	125 (11.75)	17 (13.5)	157 (13.5)	0.171	1 (2.56)	0.060	300 (12.43)
Cat epithelium	3 (0.28)	1 (0.54)	15 (1.29)	**0.025[b]**	0 (0)	0.575	19 (0.78)
Dog epithelium	1 (0.09)	0 (0)	13 (1.12)	**0.004[b]**	0 (0)	0.630	14 (0.58)
Budgerigar feathers	110 (10.34)	12 (6.45)	108 (9.29)	0.231	3 (7.69)	0.693	233 (9.65)
Cockroach	98 (9.21)	9 (4.84)	111 (9.55)	0.111	2 (5.13)	0.390	220 (9.11)

[a]: Independent t-test, [b]: Fisher's exact test, AR: Allergic rhinitis, AD: Atopic dermatitis

Table 3. Symptom distribution according to allergen sensitivities (%)

Allergen (n)	Cough (n, %)	Wheezing (n, %)	Nasal symptoms (n, %)
Dermatophagoides farinae (1384)	1209 (87.35)	541 (39.08)	873 (63.07)
Dermatophagoides pteronyssinus (1389)	1212 (87.25)	544 (39.16)	881 (63.42)
Grass pollens (1186)	1026 (86.50)	453 (38.19)	763 (64.33)
Trees-1 (early flowering) (1398)	859 (61.44)	388 (27.75)	530 (37.91)
Trees-2 (mid-season flowering) (671)	589 (87.77)	270 (40.23)	426 (63.48)
Weed pollens (431)	377 (87.47)	162 (37.5)	261 (60.55)
Grass and cereal pollens (365)	309 (84.65)	137 (37.53)	238 (65.20)
Molds (299)	255 (85.28)	107 (35.78)	187 (62.54)
Cat epithelium (19)	16 (84.21)	13 (68.42)	11 (57.89)
Dog epithelium (14)	13 (92.85)	9 (64.28)	13 (92.85)
Budgerigar feathers (230)	209 (90.86)	82 (35.65)	150 (65.21)
Cockroach (218)	201 (92.20)	79 (36.23)	129 (59.17)

Discussion

In recent years, there has been a significant increase in the prevalence of allergic diseases and asthma. To compare studies on this subject, the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaires have been used (10,11). ISAAC surveys from different regions have reported wide variations in the prevalence of allergic diseases and asthma, with rates observed at 20% in the Unites States of America, 1.6% in Indonesia, and 36.8% in the United Kingdom (12). The increase in allergic diseases has been attributed to high socioeconomic status and good hygiene conditions, though genetic predisposition and environmental factors also play a role in the etiology along with the hygiene hypothesis (13,14).

SPT is a widely used, inexpensive, easy, quick, and reliable diagnostic method for allergic diseases. The primary purpose of performing SPT is to evaluate type I hypersensitivity reactions in the skin. Histamine plays a major role in the allergic skin test response. Many allergens in our environment, such as house dust, pollens, molds, and animal epithelia, can cause disease in sensitive individuals. SPT results can be used to map allergen sensitivity.

In our study, we retrospectively evaluated the SPT results of 2413 patients performed between March 2012 and February 2014 at University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital. SPT was negative in 23.8% of patients, while 76.2% showed sensitivity to at least one allergen. Nam and Lee (15) found a general positive SPT response rate of 59.8% in patients over the age of 10, with most allergen sensitivities decreasing with age. Şahiner et al. (16) reported a positive SPT rate of 35.1%. In İstanbul, Küçükosmanoğlu et al. (17) found a 17.2% positivity rate in children's allergy skin tests, while İğde et al. (18) reported a rate of 45.9% in the Central Black Sea Region. The positivity rates of SPT in various regions of our country have ranged from 17% to 64% (3,17-22). In terms of diagnoses, 44% of the patients were diagnosed with asthma, 7.7% with AR, and 58.9% with both asthma and AR. Kulalert et al. (23) conducted a study in Thailand between 2020-2021 with 688 children. They found that 667 children (96.95%) were diagnosed with allergic rhinitis (AR) and 209 children (30.38%) with asthma. According to the DPT (skin prick test) results, more than 95% positivity was observed (23).

In a study by Topal et al. (22), the most common aeroallergens in children diagnosed with asthma and AR in the Malatya Region were grass/cereal pollen mixtures (48.9%) and weed pollen mixtures (48.5%). Additionally, 44.1% of patients had eosinophilia, and 69.6% had total IgE levels ≥100 IU/dL (22). The high sensitivity to grass/cereal pollens in hot and dry regions explains the frequent detection of this sensitivity in the Malatya Region. Similarly, studies in hot and dry climates have also found the most common sensitivity to be to grass/cereal pollens.

In a study conducted by Canbal (20) the most frequent sensitivity among children with allergic asthma and AR in the Karaman Region was found to be to wild grasses at a rate of 26.4%. Among the patients with allergic reactions to wild grass pollens, 80% showed positivity for meadow grass and couch grass. Allergens were classified into indoor and outdoor allergens, with the highest sensitivity indoors being to house dust mites (14.1%) (20). These mites, which are strong immunogens, are more commonly found in poorly ventilated, cramped, energy-efficient homes. In the same region, a study by Şahiner et al. (16) revealed that grass was the most frequently encountered allergen, followed by house dust mites. In our study, sensitivity to grass pollen was found to be 63.63%, to weed pollen 19.69%, and to grass and cereal pollen 16.85%. In Nassikas et al.'s (24) study, the relationship between pollen sensitivity and lung function was evaluated, and it was shown that concomitant diagnoses of asthma and AR in patients with pollen sensitivity affected their lung functions.

In our study, the most common positive response was to house dust mites (*D. pteronyssinus* 57.48% and *D. farinae* 57.27%). Two different studies conducted in China have shown that the most commonly detected aeroallergens were *D. pteronyssinus* and *D. farinae*. In these studies, it was found that sensitivity to *D. pteronyssinus* and *D. farinae* was significantly higher in males and in patients diagnosed with both asthma and AR (25,26). In the Central Black Sea Region, İğde et al. (18) found the highest allergen sensitivity to be 97% for house dust mites, with no significant differences in allergen frequency among various respiratory allergic diseases. The frequency of sensitivity to house dust mites in atopic individuals was found to be normally distributed at 52.5±13.44% across Turkey (18). Katotomichelakis et al. (27) also found house dust mites to be the most common aeroallergen sensitivity in children with AR in Northeast Greece.

In the Eastern Black Sea Region, Ayvaz et al. (3) reported the highest positive rates in SPT results for grass and weed pollens, followed by house dust mites. The high prevalence of house dust mites in the Black Sea Region, along with the region's vegetation and climate conditions, explains the

frequent positive results for grass, weed, tree, and house dust mite pollens (3).

Similar findings to our study were observed by Küçükosmanoğlu et al. (17) in İstanbul, where house dust mites were the most common sensitivity, followed by grass pollens. The study emphasized the importance of indoor allergens in the development of asthma due to children's increased time spent indoors and the direct impact of indoor factors on the respiratory system (17).

Araz's (19) evaluation of children with chronic cough showed that 57.1% of patients had sensitivity to at least one allergen. The data were expected to contribute to the identification of allergen distribution in the region and provide insights into the etiology of chronic cough (19).

In adults, a study found sensitivities of 71% to mites, 42% to molds, and 36% to grass pollens. A negative correlation between age and sensitivity to grass pollens was reported. The study also found sensitivities of 32% to cockroaches, 22% to animal epithelia, and 42% to molds, with a close relationship between molds, animal epithelia, and asthma (28). In a study conducted by Khreesha et al. (29) in Jordan, olive pollen was identified as the most common allergen in both pediatric and adult populations. The study also demonstrated that sensitivity to aeroallergens decreased with increasing age (29).

Çölgeçen et al. (30) showed that aeroallergens, through inhalation or direct skin contact, exacerbated the disease in some patients with AD, with clinical symptoms reducing after allergen exposure ceased. The study recommended first investigating triggering agents, followed by SPT or specific IgE antibody testing. In patients with AD, 73.2% showed sensitivity to wheat pollen, attributed to the prevalence of farming in the region (30). In the study by Wongpiyabovorn et al. (31), it was observed that house dust mites, specifically *D. pteronyssinus* and *D. farinae*, showed a high level of correlation between the SPT results and specific IgE levels. Baykan et al. (32) found rye pollen sensitivity to be the second most common after grass pollen, linked to the frequent harvesting of rye in the Central Anatolia Region.

Although SPT results have a sensitivity close to 100%, their specificity remains around 50%, necessitating support from specific IgE measurements.

Karabulut et al. (33) evaluated SPT results based on meteorological and demographic characteristics and found that 46.1% of patients were housewives, 9.6% were healthcare workers, 18.1% were teachers, and 26.3% were from other professions. The most common sensitivities were to tree pollen mixtures (49.7%) and grass pollen mixtures (48.6%). House dust mite sensitivity (60.7%) was second among housewives, attributed to frequent exposure to indoor allergens. Sensitivity to tree pollens was highest during months with low humidity and rainfall. Nasal and eye symptoms were significantly higher among housewives and healthcare workers, while respiratory and skin symptoms were common among housewives. Correlations were found between nasal itching and headache with house dust mites, and eye symptoms with year-round allergens like house dust, cockroaches, molds, and egg whites (33).

Conclusion

In conclusion, our study found the most common allergen sensitivity to be against house dust mites and grass pollen. SPT results reflect the characteristics of the regions where they are performed. Identifying aeroallergen sensitivity in children diagnosed with asthma, AR, and AD using SPT plays a key role in their treatment and follow-up.

Ethics

Ethics Committee Approval: After obtaining ethical committee of University of Health Sciences Turkey, Bakırköy Dr. Sadi Konuk Training and Research Hospital approval, the results of the skin prick tests conducted were retrospectively evaluated (approval date: 05.05.2014, decision number: 2014/07/33).

Informed Consent: Informed consent was obtained from all individual participants included inthe study.

Footnotes

Authorship Contributions

Concept: E.E.S., N.A., E.Ş., Design: E.E.S., N.A., Data Collection or Processing: E.E.S., N.A., E.Ş., Analysis or Interpretation: E.E.S., N.A., E.Ş., Literature Search: E.E.S., N.A., Writing: E.E.S.

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