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RHINOLOGY

Does adenoid hypertrophy affect disease severity in children with allergic rhinitis?

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Abstract Our study aims to evaluate the presence of adenoid hypertrophy (AH) in children with allergic rhinitis (AR) and the association of AH disease severity and clinical laboratory finding from retrospective, cross-sectional, and nonrandomized trial. The study included 566 children being treated and followed up for allergic rhinitis. Skin prick test for the same allergens was performed for all patients. Adenoid tissue was analyzed by an ENT specialist and the diagnosis was confirmed based on the patient history, endoscopic physical examination and radiology. Adenoid hypertrophy was detected in 118 (21.2 %) of the children with AR. Children with and without AH did not differ statistically and significantly by gender, age, presence of atopy in the family, exposure to smoke ($p > 0.05$). Comparison of the groups for AR duration demonstrated significantly higher frequency of persistent rhinitis in patients with AH ($p < 0.05$). Of the AR patients with AH, 90 (76.3 %) had moderate-severe rhinitis and 274 (62.6 %) AR patients without AH had moderate-severe rhinitis ($p = 0.005$). Itchy nose was more frequent in AR patients without AH, and nasal congestion was more common in AR patients with AH ($p = 0.017$ and $p = 0.001$, respectively). The presence of asthma was more common among AR patients without AH ($p = 0.037$). Intergroup comparisons for presence of atopic dermatitis, the percentage of eosinophil, serum IgE levels, the number of positive sensitivity, polysensitization, sensitivity to house dust mite, cockroach, pollens and dander yielded no significant difference ($p > 0.05$). On the other hand, sensitivity to *Alternaria alternata* was significantly more frequent in AR patients with AH ($p = 0.032$). The presence of AH increased the severity of the disease and prolongs disease duration. There was a negative relationship between AH and asthma in children with AR. AH is more common among children with mold sensitivity. AH should be considered and investigated particularly in non-asthmatic children with pronounced nasal congestion and *A. alternata* sensitivity.

Keywords Adenoid hypertrophy · Severity · Allergic rhinitis · Asthma

Introduction

Allergic rhinitis is clinically defined as a symptomatic disorder of the nose induced after allergen exposure by an IgE-mediated inflammation. Allergic rhinitis is the most common form of noninfectious rhinitis. Allergic rhinitis is a global health problem that causes major illness and disability worldwide. Symptoms of allergic rhinitis include rhinorrhoea, nasal obstruction, nasal itching and sneezing [1]. Adenoid tissue is the peripheral lymphoid organ located in the roof of the rhinopharynx and is part of the Waldeyer's ring. Adenoid tissue contributes to the development of immunity against inhaled microorganisms in early life. Hypertrophy of this adenoid tissue that has important functions for the body is a common morbidity of

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childhood. Adenoid hypertrophy (AH) has been associated with nasal obstruction, snoring, sleep apnea, recurrent otitis media, recurrent rhinosinusitis infections, and craniofacial anomalies [2, 3]. In our previous study where we investigated AH and its effects in allergic conditions, we had found that AH was more common in allergic conditions [4]. Both AR and AH is an important cause of morbidity in childhood. AH is a condition that needs to be considered in differential diagnosis and has similar symptoms [1]. AH presence in patients with allergic rhinitis was evaluated by previous studies [5–8]. However, we know a little about the relationship between AR severity and presence of AH [9].

Our study aims to evaluate the relationship between presence of AH and AR severity and clinical laboratory findings in children with AR.

Materials and method

The study included 556 children who were under follow-up for AR by pediatric allergy-immunology outpatient clinic between June 2012 and May 2014. Patients were evaluated retrospectively. Detailed allergic disease history at the time of first presentation was obtained. Patients' age, gender, familial atopy history and exposure to smoke were recorded. Presence of atopy in the family was considered as positive if a first-degree relative (mother, father, and sibling) had allergic disease. Allergic rhinitis diagnosis was based on ARIA guideline [1]. Duration of AR was classified according to the ARIA guidelines as persistent (symptoms lasting more than 4 days a week and over more than 4 weeks) or intermittent (symptoms lasting up to 4 days a week or up to 4 weeks). AR severity was assessed according to the four ARIA items (sleep, daily activities/sport/leisure, academic performance, and troublesome symptoms) and classified according to different severity levels as mild (no affected items) or moderate/severe (one or more affected items) based on the ARIA classification [1].

The study was approved by the Istanbul Medipol University Ethics committee and adhered to the principles of Helsinki Declaration. An oral consent was obtained from all subjects and/or their parents.

Evaluation of adenoid hypertrophy presence

Adenoid tissue disease was diagnosed by ear nose and throat specialists based on history and endoscopic physical examination. In children not cooperating with endoscopic examination, AH was investigated using lateral nasopharyngeal radiography. Adenoid-nasopharyngeal ratio was studied based on the Fujioka method [10]. Adenoidal hypertrophy was considered when the AN ratio was higher than 0.8 [10]. Grades 3 and 4 with flexible endoscopic examination were considered as adenoidal hypertrophy [11]. Nasal steroids reduce the size of the adenoid tissue. Therefore, patients who received regular drug treatment over the last 6 weeks were excluded from the study.

Skin prick tests

Skin prick tests for common aeroallergens (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinea*, mixture of grass pollens (*Lollium perenne*, *Dactylis glomerata*, *Phleum pratense*, *Anthoxanthum odoratum*, *Poa pratensis*, *Festuca eliator*, *Agrostis vulgaris*, *Holcus lanatus*, *Cynodon dactylon*, *Avena sativa*, *Avena fatua*, *Lotus Corniculatus*), a mixture of grain pollens (oats, wheat, barley, corn), a mixture of tree pollens (*Acer pseudoplanatus*, *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Tilia platyphyllos*, *Platanus vulgaris*), weed-mix pollens (*Medicago sativa*, *Trifolium pratense*, *Brassica nigra*, *Urtica dioica*, *Rumex acetosa*), *Alternaria alternata*, cockroaches (*Blatella germanica*), cat dander and dog dander (Stallergenes SA, 92160 Antony, France) were performed using stallerpoint (Stallergenes SA, 92160 Antony, France). Patients with a positive history of food reactions underwent skin prick tests with the suspected food. Skin prick tests were applied on the anterior forearm. Patients were considered eligible for the skin test if they have not received antihistamines for at least 1 week. Histamine (10 mg/ml) and physiological saline were used as positive and negative references, respectively. Skin reactions were evaluated at 20th minute of the application, and a positive reaction was characterized as 3 mm or greater than that of the negative control. Sensitization to a single allergen meant patients were monosensitive. If sensitization to different allergen groups was detected, the patient was classified as being polysensitive.

Statistical analysis

Data was analyzed using the program Statistical Package for Social Sciences (SPSS for Windows 15.0 Chicago, USA). Values for continuous variables were given as either mean ± standard deviation or as median (interquartile range), based on the normality of distribution. Student's *t* test was used in the comparison of normal and homogeneous distribution of the parametric values. Chi-square and Mann–Whitney *U* test were used to compare nonparametric values. $p < 0.05$ was considered the significant value.

Results

Of the patients, 329 (59.2 %) were male and their mean age was 7.2 ± 3.4 (2–18) years. Adenoid hypertrophy was detected in 118 (21.2 %) of the children with AR. Patients

were divided into two groups according to AH presence, as AR patients with AH (Group I) and AR patients without AH (Group II). AR patients with and without AH did not differ statistically and significantly with respect to gender, age, age groups, presence of atopy in the family, and exposure to smoke ($p > 0.05$) (Table 1).

The comparison of the groups for AR duration demonstrated that AR patients with AH had significantly higher persistent rhinitis frequency (66.1 and 34.5 %, respectively) ($p < 0.05$). Of the AR patients with AH, 90 (76.3 %) had moderate-severe rhinitis compared to 274 patients without AH (62.6 %) with moderate-severe rhinitis. This difference was statistically significant ($p = 0.005$). The comparison of AR symptoms demonstrated no intergroup differences for nasal discharge and sneezing, but itchy nose was more common in AR patients without AH and nasal congestion was more common in AR patients with AH ($p = 0.017$ and $p = 0.001$, respectively). There were no differences between the groups for presence of atopic dermatitis, but asthma presence was more common among AR patients without AH ($p = 0.037$). The duration of disease was significantly longer in AR patients with AH ($p = 0.022$) (Table 2).

There was no statistically significant difference between the groups with regard to percentage of eosinophil, serum IgE levels, the number of positive sensitivity, polysensitization, sensitivity to house dust mite, sensitivity to pollens, sensitivity to dander and sensitivity to cockroach ($p > 0.05$), while sensitivity to *A. alternata* was significantly more common in AR patients with AH ($p = 0.032$) (Table 3).

Diagnosis was made with lateral nasopharyngeal radiography in 54 of the patients with AH (45.8 %) and endoscopically in 64 (54.2 %). There is no significant difference with AH diagnostic method with respect to AR severity and duration ($p > 0.05$).

Table 1 Comparison of sociodemographic characteristics of the groups

	Group I *n*: 118	Group II *n*: 438	*p*
Gender (M/F)	72/46	257/181	0.646[a]
Age, (years)[c]	7.1 ± 3.1	7.3 ± 3.6	0.713[b]
Age groups (years)			0.260[a]
2–6	61 (24)	193 (76)	
6–12	47 (19.7)	191 (80.3)	
12–18	10 (15.6)	54 (84.4)	
Familial atopy, *n* (%)	60 (50.8)	195 (44.5)	0.221[a]
Exposure to smoke, *n* (%)	61 (51.7)	200 (45.7)	0.244[a]

[a] Chi-square test

[b] Student's *t* test

[c] Mean ± standard deviation

Table 2 Comparative clinical findings of the groups

	Group I *n*: 118	Group II *n*: 438	*p*
Classification by AR duration, *n* (%)			
Intermittent	40 (33.9)	287 (65.5)	0.001[a]
Persistent	78 (66.1)	151 (34.5)	
Classification by AR severity, *n* (%)			
Mild	28 (23.7)	164 (37.4)	0.005[a]
Moderate/severe	90 (76.3)	274 (62.6)	
Nasal discharge, *n* (%)	102 (86.4)	370 (84.5)	0.567[a]
Itch, *n* (%)	100 (84.7)	403 (92)	0.017[a]
Sneezing, *n* (%)	103 (87.3)	401 (91.6)	0.158[a]
Congestion, *n* (%)	114 (96.6)	371 (84.7)	0.001[a]
The presence of asthma, *n* (%)	54 (45.8)	246 (56.2)	0.037[a]
The presence of atopic dermatitis, *n* (%)	10 (8.5)	40 (9.1)	0.819[a]
Severity of Allergic rhinitis, *n* (%)			0.001[a]
Mild intermittent	21 (17.8)	153 (34.9)	
Mild persistent	7 (5.9)	11 (2.5)	
Moderate/severe intermittent	19 (16.1)	134 (30.6)	
Moderate/severe persistent	71 (60.2)	140 (32)	
Duration of disease (month)[c]	24 (12–36)	20 (12–36)	0.022[b]

[a] Chi-square test

[b] Mann–Whitney *U* test

[c] Median (interquartile range)

Table 3 Comparative laboratory data of the groups

	Group I *n*: 118	Group II *n*: 438	*p*
Immunoglobulin E[c]	237 (69.5–624)	252 (84.5–677.5)	0.496[b]
Percentage of eosinophil, (%)[c]	3.4 (2.1–6.3)	4.4 (2–7.4)	0.174[b]
The number of positive sensitivity[c]	2 (1–3)	2 (2–3)	0.292[b]
Polysensitization, *n* (%)	41 (34.7)	173 (39.5)	0.346[a]
Sensitivity to house dust mite, *n* (%)	99 (83.9)	389 (88.8)	0.148[a]
Sensitivity to pollens, *n* (%)	37 (31.4)	126 (28.8)	0.583[a]
Sensitivity to dander, *n* (%)	18 (15.3)	87 (19.9)	0.256[a]
Sensitivity to *A. alternata*, *n* (%)	9 (7.6)	14 (3.2)	0.032[a]
Sensitivity to cockroach, *n* (%)	6 (5.1)	40 (9.1)	0.157[a]

[a] Chi-square test

[b] Mann–Whitney *U* test

[c] Median (interquartile range)

Discussion

We determined a longer duration and higher severity of allergic rhinitis as measured by ARIA classification in children with AR who had AH. Increased severity and duration of symptoms in simultaneous presence of two diseases with similar findings is an expected outcome. The results of our study were consistent with this. Evaluating comorbidities in children with AR, Ibanez et al. [9] found higher severity and longer duration of AR in children with AH. We believe that worsening of nasal congestion with AH and more frequent nasal discharge due to recurrent adenoiditis and rhinosinusitis increases the severity and prolongs the duration of existing allergic rhinitis in children with AH.

We determined an AH frequency of 21.2 % in children with AR. The results of the relevant studies in children vary. Investigating AH presence in allergic children, Modrzynski et al. [6] found an AH frequency of 70.7 % in children with AR only compared to 78.5 % in children with coexisting AR and another allergic disease (asthma and/or atopic dermatitis). In our previous study where we investigated AH frequency in children with allergic conditions, we had found that 15.4 % of children with AR had AH [4]. In their study in Spain, Ibanez et al. [9] found AH in 17.3 % of children with AR. The frequency in the study by Modrzynski et al. [6] is markedly higher compared to other studies. This may be because, the study evaluated children aged 4–9 years because the volume of the adenoid increases with age, and reaches maximal volume in the age group of 5–6 years, followed by a gradual decrease in volume by the age of 8–9 years [3]. This study evaluated patients in the age group where adenoid tissue reaches maximum volume. Besides, this study examined AH presence only in children sensitive to house dust mite. In the study by Ibanez et al. [9], children aged 6–12 years were evaluated. We believe that our study reflects real-life conditions better because it covers almost the whole childhood (ages 2–18 years) and covers different types of allergen sensitivities.

In our study, itchy nose was more common in AR patients without AH and nasal congestion was more common in AR patients with AH. There were no differences between the groups for nasal discharge and sneezing. Symptoms comparisons were not made in previous studies [5, 6, 8]. Eren et al. [7] studied AR symptoms in 155 children with AH and found itchy nose and sneezing to be predictors for AR. In our study, AR patients with AH were not different from the patients with AR only with regards to discharge and sneezing but had itching less frequently. Nasal congestion and snoring are the primary symptom of AH nasal congestion and is expected to be more common among AH patients. Nasal discharge, especially discharge in the nasal cavity can be seen in AR patients with AH due to recurrent adenoiditis and rhinosinusitis. Nasal discharge is more common in AH patients but the difference was not significant. Both itching and sneezing was more common in AR without AH patients. But only the difference between the groups in itching was significant.

One of the interesting results of our study was that asthma was less common in AR patients with AH compared to AR alone. There is little relevant information in the literature. In a study we investigated AH in children with allergic diseases previously, asthma was less frequent in allergic patients with AH although the difference was not significant ($p = 0.055$) [4]. Modrzynski et al. [6] found significantly lower frequency of asthma in AR patients with AH. Asthma, which is an allergic condition like AR, is expected to be more frequent in AH patients, but there seems to be an inverse relationship between the presence of asthma and AH in allergic children. More comprehensive studies are needed on this subject.

In our study, only *A. alternata* sensitivity was higher in AR patients with AH in the comparison of allergen sensitivities between AR patients with and without AH. In the study by Modrzynski et al. [6], pollen and molds allergen sensitivities were higher in children with AH, compared to children without AH, with allergic disease. We investigated AH in children with AR in our study. Pollen sensitivity was higher among children with AH but the difference was not statistically significant. The difference in our results for pollen sensitivity can be due to the different population of our study. In another study, Huang et al. [8] compared clinical and laboratory findings of 315 children with AR and children with AR + AH and found that the prevalence of positive reactivity to molds was significantly higher in the group with AH and AR (p ranged from 0.013 to <0.0001 and the relative risk ranged from 1.609 to 2.375). In addition, the risk of AH was positively correlated with number of skin test reactivity to mold spores (p ranged from 0.0035 to 0.0001). In our study, we evaluated only *A. alternata* sensitivity among fungal sensitivities. Nevertheless, we found that *A. alternaria* sensitivity was more frequent in AR patients with AH. Based on these studies, we emphasize that children with AR, especially those with fungal sensitivity should be investigated for AH.

The limitation of our study was that it was not a community based study but included only the patients presenting to tertiary care healthcare centers. However, the study included patients from almost the whole childhood for AR and our patient number was high for a single center, which were the strong aspects of our study. The results of our study are important since it provides information on AH presence and its effects in a common disease such as AH.

In conclusion, the presence of AH increased the severity of the disease and prolonged disease duration. Itching was less common and nasal congestion was more common among AR children with AH. There was a negative relationship between AH and asthma in children with AR. AH is more common among children with mold sensitivity. AH should be considered and investigated particularly in non-asthmatic children with pronounced nasal congestion and *A. alternata* sensitivity.

Compliance with ethical standards

The study was approved by the Istanbul Medipol University Ethics committee and adhered to the principles of Helsinki Declaration. An oral consent was obtained from all subjects and/or their parents.

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