*Original Article / Çalışma - Araştırma*

# Effect of adenoid hypertrophy and pulmonary function tests in children with mild asthma

## Hafif derecede astımlı çocuklarda adenoid hipertrofisinin akciğer fonksiyon testlerine etkisi

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***ABSTRACT***

**Objectives:** This study aims to assess the effect of adenoid hypertrophy on asthma in children with mild asthma.

**Patients and Methods:** Between September 2010 and September 2012, 63 children (42 males, 21 females; median age 10.5 years; range 6 to 14 years) admitted to our clinic with asthma complaint were included in this study. These children were evaluated for adenoid hypertrophy, symptoms of asthma, medical treatment, pulmonary function tests at the beginning of the study and at the end of second month.

**Results:** There was no correlation between initial pulmonary function tests and adenoid hypertrophy. But we observed significantly lower forced vital capacity values in children with prominent adenoid hypertrophy (p=0.033). While there was no significant difference in pulmonary function tests in terms of inhaled steroid usage (p>0.05), final forced mid-expiratory flow rate ($FEF_{25-75}$) values were statistically higher in patients who were using nasal steroids (p=0.015).

**Conclusion:** Consequently, significantly higher values of $FEF_{25-75}$ in the group that used nasal steroid suggest that adenoid hypertrophy affects the airway obstruction. Moreover, absence of airway obstruction symptoms in patients with mild adenoid hypertrophy suggests pulmonary function tests may help to decide performing adenoidectomy.

***Keywords:*** Adenoid hypertrophy; asthma; montelukast; nasal corticosteroid; pulmonary function tests.

***ÖZ***

**Amaç:** Bu çalışmada hafif derecede astımlı çocuklarda adenoid hipertrofisinin astıma etkisi değerlendirildi.

**Hastalar ve Yöntemler:** Eylül 2010 - Eylül 2012 tarihleri arasında astım yakınması ile kliniğimize başvuran 63 çocuk hasta (42 erkek, 21 kız; median yaş 10.5 yıl; dağılım 6-14 yıl) çalışmaya dahil edildi. Bu çocuklar adenoid hipertrofisi, astım semptomları, medikal tedavi, çalışmanın başlangıcında ve ikinci ay sonundaki solunum fonksiyonları testleri ile değerlendirildi.

**Bulgular:** Başlangıçtaki akciğer fonksiyon testleri ile adenoid hipertrofisi arasında bir ilişki saptanmadı. Fakat belirgin adenoid hipertrofisi olan çocuklarda zorlu vital kapasite değerleri ileri derecede düşük izlendi (p=0.033). İnhale steroid kullanımıyla ilgili olarak akciğer fonksiyon testlerinde belirgin farklılık izlenmezken (p>0.05), nazal steroid kullanan hastalardaki son zorlu ekspirasyon ortası akım hızı ($FEF_{25-75}$) değerleri istatistiksel olarak yüksek izlendi (p=0.015).

**Sonuç:** Sonuç olarak; nazal steroid kullanan grupta $FEF_{25-75}$ değerlerinin anlamlı olarak daha yüksek olması adenoid hipertrofisinin hava yolu obstrüksiyonunu etkilediğini düşündürmektedir. Ayrıca hafif adenoid hipertrofili hastalarda hava yolu obstrüksiyonu bulgularının olmayışı solunum fonksiyon testinin adenoidektomiye karar vermede yardımcı olabileceğini düşündürmektedir.

***Anahtar Sözcükler:*** Adenoid hipertrofisi; astım; montelukast; nazal kortikosteroid; akciğer fonksiyon testleri.

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Adenoid hypertrophy is a known response to antigenic stimulation.[1,2] According to recent studies allergen presentation in allergic rhinitis may result in adenoid tissue growth.[3] Moreover adenoid hypertrophy has been detected in patients with allergic rhinitis and asthma.[4]

Adenoid hypertrophy can result in respiratory flow disturbance, but can also present without any clinical and radiological signs.[5] A study found that among patients with adenoid hypertrophy and no other comorbidity, 52% had lower airway obstruction findings on pulmonary function tests.[6] Although few reports in the literature suggest improvement of pulmonary function tests after adenoidectomy, there are not enough studies on the effect of adenoid hypertrophy in asthmatic patients and their impact on pulmonary function tests.

Our study aimed to assess the effect of adenoid size on asthma in asthmatic children.

## PATIENTS AND METHODS

This study was conducted in our hospital between September 2010 and September 2012. The participants were 63 patients with asthma (42 males, 21 females; median age 10.5 years; range 6 to 14 years). The exclusion criteria were used nasal steroids and leukotriene receptor antagonists during the last two months and systemic and nasal decongestants during the last week. The inclusion criteria were patients with Brodsky stage 1 tonsillar hypertrophy, patients without nasal pathology such as septum deviation and nasal polyp, and patients who could perform pulmonary function tests. Informed consent was obtained from all participants. Medical and family history including social demographic information, family history of asthma, tobacco exposure, pet exposure, wheezing history on food, climate, dust and exercise were collected from an inventory performed by a senior physician.

Total of 68 patients were enrolled the study. Five of the patients drop outs for inapropriate use of nasal steroids (n=3) and catch the end the two months visit (n=2). The study completed with 63 patients. Twenty-eight of the patients were treated with nasal mometasone furoate 50 mcg in each nasal cavity once daily over two months for allergic rhinitis. Twenty-six of the patients were used also asthma medication (15 of the 26 patients treated with inhaled corticosteroids and 11 montelukast for asthma. All patients were evaluated at the beginning and end of the two months of treatment for pulmonary function tests, symptoms and drug requirements. All patients were asked about asthma attacks, symptom free periods, beta-2 agonist need, emergency department attendance and hospitalization. Additionally pulmonary function tests were performed by the same technician.

The protocol was approved by the Dr. Lütfi Kırdar Kartal Training and Research Hospital Ethics Committee and informed consent was obtained from each parent. The study was conducted in accordance with the principles of the Declaration of Helsinki.

### Pulmonary function tests (PFT)

Vital capacity and flow rates were measured by spirometry according to American Thoracic Society (ATS) criteria with patients awake and seated.[7] Spirometry values were expressed as the ratio of percentage of normal values based on age, gender, and height. The best values of a minimum of three adequate measurements were taken. Reference values obtained by Knudson et al.[8] were used.

### Ear nose and throat assessment

Systemic ear, nose, and throat examination was performed by a senior physician. If there was a pathology on physical examination the participant was excluded from the study. Adenoid size were assessed with a 2.7 mm diameter, 0 degree nasal telescope (Karl-Storz GmbH & Co. KG, Tuttlingen, Germany) after nasal decongestion with 0.025% oxymetazoline (Santa Farma, İstanbul, Turkey) solution for better visualization of the choanal area. All patients were divided into four groups according to our modified scoring system for adenoid vegetation:

- Stage 1- Adenoid vegetation tissue obstructed less than 25% from the upper edge of the choanal border.
- Stage 2- Adenoid vegetation tissue obstructed between 26-50% from the upper edge of the choanal border.
- Stage 3- Adenoid vegetation tissue obstructed between 51-75% from the upper edge of the choanal border.

- Stage 4- Adenoid vegetation tissue obstructed over 76% from the upper edge of the choanal border.

**Statistical analysis**

Statistical analyses were performed using PASW version 17.0 software (SPSS Inc., Chicago, IL, USA). Continuous variables were described through means, standard deviations, whereas categorical variables were presented as proportions. Categorical variables were compared using chi-square and Fisher's exact test when 20% of the expected frequencies were less than five. Continuous variables between two groups were compared with Student t test, since the data followed a normal distribution. Bivariate correlations were evaluated through Spearman's rank correlation and presented as correlation coefficients. $P<0.05$ was considered statistically significant.

## RESULTS

The mean age of the patients were 10.3±2.1 years (range 6-14 years). Forty-two (66.7%) of the 63 patients were male and 21 were female. Ten patients had a family history of asthma. Thirty (47.6%) of the patients have tobacco exposure. Most of the patients has stage 1 and stage 2 adenoid size (Table 1).

There were no correlations between initial forced vital capacity (FVC) ($p>0.05$, $r=-0.15$), forced expiratory volume 1 second ($FEV_1$) ($p>0.05$, $r=-0.07$), Forced expiratory flow 25-75 ($FEF_{25-75}$) ($p>0.05$, $r=-0.14$) and adenoid hypertrophy but FVC values were significantly lower in patients with prominent (stage 3 and 4) adenoid hypertrophy ($p=0.033$) (Table 2). There were no correlations between adenoid hypertrophy and asthma attacks, symptom free days ($p>0.05$), beta-2 agonist need ($p>0.05$), and emergency attendance ($p>0.05$).

At the end of the second month, the PFT values were not statistically different between the inhaled corticosteroid and montelukast group ($p>0.05$) (Table 3). At the end of two months, FEF 25-75 values were statistically higher in patients who were using nasal steroids ($p=0.015$) (Table 4).

**Table 1.** Adenoid size of the patients

| Adenoid size | n | % |
|---|---|---|
| Stage 1 | 31 | 49.2 |
| Stage 2 | 19 | 30.2 |
| Stage 3 | 5 | 7.9 |
| Stage 4 | 8 | 12.7 |

## DISCUSSION

A current study shows that adenoid hypertrophy may lead to disturbances in respiratory flows, often with no clinical and radiological symptoms and signs.[5] The reduction of air flow during inspiration or expiration is an important diagnostic feature of airway obstruction. Pulmonary function tests in children without any abnormalities other than adenoid hypertrophy were performed by Maurizi et al.[6] and they concluded that 52% of patients presented features of lower airway obstruction. Modrzynski and Zawisza[9] investigated the incidence of adenoid hypertrophy in allergic children and they concluded that allergic conditions including allergic rhinitis, bronchial asthma and atopic dermatitis increased the risk of adenoid hypertrophy. Similarly, another study investigating relationship between allergic diseases, influential factors and adenoid hypertrophy concluded an increased prevalence of adenoid hypertrophy in allergic rhinitis and asthma.[10] The degree of adenoid hypertrophy and its effect on respiratory resistance are crucial in these allergic diseases. Kavukcu et al.[11] recommended the use of spirometric results as indicative criteria for adenoid surgery. They observed obstructive pulmonary disease of transient character in 60% of the examined group and the parameters indicating airway obstruction vanished after the operation. Another study showed that $FEV_1$ values remained the same whereas PEF, FVC, $FEV_1$/PEF, $FEV_1$/FVC values improved significantly after adenoidectomy.[12] Moreover, Pherwani et al.[13] investigated the comorbid conditions in allergic children and detected mild to moderate airway obstruction on spirometry including those who did not have any history or symptoms of asthma.

All these studies were conducted with study groups composed of adenoid vegetation totally or nearly-totally obstructing the nasopharynx. In our study group a great majority of the subjects (79.4%) had grade 1 and 2 adenoid hypertrophy. When we compare our results with these reports, we can conclude that our study groups' upper airway resistance was less blocked. The correlation

**Table 2.** Initial pulmonary function tests results comparison with percentage of adenoid obstruction

| Adenoid vegetation* (%) | 0-50 | >50 | |
|---|---|---|---|
| | Mean±SD | Mean±SD | *p* |
| Forced vital capacity | 106.0±11.6 | 98.6±10.0 | 0.033 |
| Forced expiratory volume in one second | 99.1±12.8 | 99.6±8.9 | 0.888 |
| Forced expiratory flow 25-75 | 90.5±27.1 | 100.9±23.9 | 0.201 |

* The percentage of the adenoid vegetation obstruction in the choanal area; SD: Standard deviation.

between adenoid hypertrophy and pulmonary function tests was not statistically significant but when we compare grade 3 and 4 with grade 1 and 2 hypertrophy, we can detect decreased levels of FVC in the former. Consistent with previous reports, our data suggests that patients with mild degrees of adenoid hypertrophy can be evaluated by pulmonary function tests in order to make a decision about surgery.

Some studies claimed that the main obstruction in adenotonsillar hypertrophy patients occurred in the inspiratory phase. They reported that FIF50% was significantly low whereas ratio of forced expiratory flow at 50% of vital capacity to forced inspiratory flow at 50% of vital capacity (FEF50%/FIF50%) ratio was higher than one.[14] In our study we only investigated the expiratory stage of the PFT; for this reason we cannot evaluate the adenotonsillar and inspiratory relationship.

The $FEF_{25-75}$ value of the PFT investigates small airway disease, which is also shown by the $FEV_1$ value. Although the $FEV_1$ and FVC are not yet affected, the $FEF_{25-75}$ value can be decreased. This value is the early sign of obstruction.[15] In our study, the end $FEF_{25-75}$ value was statistically higher in patients who use nasal steroids but the $FEV_1$ and FVC values were not different. This data can be related with the level of adenoid hypertrophy.

We have some limitations in our study. First, we should have evaluated the final adenoid size to clarify the effect of treatment at the end of two months, and the expiratory phase of the PFT should have been evaluated before and after the study. Secondly, we could have performed adenoidectomy to evaluate the surgical benefits for these patients.

A previous report showed that 40% of children with allergic rhinitis was associated with asthma, while 50 to 80% cases of asthma had allergic rhinitis.[16] Adenoid hypertrophy has ability to affect respiratory function. The control of allergic symptoms can be beneficial to control asthma

**Table 3.** Pulmonary function tests values according to inhaled corticosteroids or montelukast usage

| Drugs | FVC | $FEV_1$ | $FEF_{25-75}$ |
|---|---|---|---|
| | Mean±SD | Mean±SD | Mean±SD |
| Inhaled corticosteroid | | | |
| Variables | | | |
| Using | 99.9±13.0 | 97.2±13.1 | 93.4±21.7 |
| Not using | 103.5±12.1 | 97.9±12.9 | 91.3±30.9 |
| P value | 0.357 | 0.872 | 0.769 |
| Montelukast | | | |
| Variables | | | |
| Using | 100.9±11.2 | 98.2±11.7 | 95.3±23.9 |
| Not using | 100.1±18.9 | 93.8±18.1 | 82.2±22.3 |
| P value | 0.840 | 0.317 | 0.101 |

FVC: Forced vital capacity; $FEV_1$: Forced expiratory volume in one second; $FEF_{25-75}$: Forced expiratory flow 25-75; SD: Standard deviation; PFT values are not statistically different in both inhaled corticosteroid and montelukast group ($p>0.05$).

**Table 4.** Pulmonary function tests according to nasal steroid usage at the end of second month

| Variables | Using | Not using | *p* |
|---|---|---|---|
| | Mean±SD | Mean±SD | |
| Forced vital capacity | 102.7±10.0 | 99.4±14.5 | 0.324 |
| Forced expiratory volume in one second | 94.6±11.1 | 99.5±14.0 | 0.146 |
| Forced expiratory flow 25-75 | 84.4±24.6 | 99.3±21.8 | 0.015 |

SD: Standard deviation; $FEF_{25-75}$ values were statistically higher in patients who were using nasal steroids ($p<0.05$).

attacks.[17] Therefore, grade 1 and 2 adenoid hypertrophy can be treated by nasal corticosteroids and severity of the allergic rhinitis and prevalence of the asthma attacks can be protected.

In conclusion, mild adenoid hypertrophy is not correlated with airway obstruction which is measured with PFT expiratory parameters. Although we had not measured the adenoid size at the end of the second month of our study, the nasal corticosteroid treated group had statistically-increased $FEF_{25-75}$ levels supporting the obstructive effect of adenoid hypertrophy. Moreover mild adenoid hypertrophy did not cause airway obstruction that can be detected on PFT; and PFT can also be used as an instrument for operative indication.

**Declaration of conflicting interests**

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