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Research Article

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Evaluation of Pulmonary Functions in Children with Adenoid Hypertrophy

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Abstract

Objective: We conducted this study to determine the pulmonary function changes in a large cohort of children with adenoid hypertrophy in Upper Egypt.

Methods: This was a case-control study undertaken in two tertiary referral centers in Upper Egypt. Our study included 100 children with adenoid hypertrophy (mean age 7.5 years; 65 males), and 80 healthy controls (mean age 8.1 years; 48 males). Spirometric tests were performed for all participants, with the evaluation of vital capacity (VC), forced vital capacity (FVC), forced expiratory volume during the first second (FEV1), the ratio of FEV1/FVC, and the peak expiratory flow rate (PEFR).

Results: We found significant reductions in all spirometric parameters in the adenoid group in comparison with healthy children. Patients with adenoid manifestations for more than one year have considerable impairment in FEV and FEV/ FVC compared with those with symptoms for less than one year.

Conclusions: Prolonged upper airway obstruction due to adenoid hypertrophy may be associated with a decline in pulmonary functions. Spirometry should be added for the assessment of children with adenoid hypertrophy to avoid cardiopulmonary complications.

Key words: *Adenoid hypertrophy; Children; Pulmonary function; Spirometry.*

Introduction

Adenoid hypertrophy is the primary cause of upper airway obstruction in the pediatric age group and considered the most common ENT surgery performed in children [1]. The size of the lymphatic tissue filling the upper airways is highly correlated with the clinical manifestations of the disease, especially the obstructive nasal symptoms [2]. Enlarged adenoid for a prolonged time may be associated with upper airway resistance resulting in many chronic complications such as sleep-related breathing disorders, e.g., obstructive sleep apnea, chronic alveolar hypoventilation that may proceed to cardiopulmonary complications and corpulmonale [1,

3]. The cardio-respiratory effects of adenoid hypertrophy were evaluated in some studies [1-3]; however, the results were inconsistent. Therefore, we conducted this study to assess the pulmonary function changes in a large cohort of children with adenoid hypertrophy in Upper Egypt.

Materials and Methods

Study design

This was a case-control study undertaken in two tertiary referral centers in Upper Egypt: Assiut and Al-Azhar universities hospitals, Egypt. Written informed consents of parents of all children were taken after explanation of the study objectives. Faculty of Medicine, Assiut University Ethical Committee approved the study protocol.

Patients

All children under 18 years referred with adenoid hypertrophy to our tertiary Hospitals, Assiut, Egypt, from 2015 to 2018, constituted the study population. The diagnosis of adenoid hypertrophy was made by senior ENT consultant. We excluded all patients with any of the following conditions: respiratory and cardiovascular diseases, thoracic deformities, nasal pathologies (e.g., nasal polyps and septum deviations, etc.), tonsillar hypertrophy, head trauma, craniofacial malformation, immune deficiency disorders, immotile cilia syndrome, and chronic kidney and liver diseases. Also, we excluded subjects with current or previous drug or tobacco history and children who cannot perform pulmonary function tests properly.

All participants are subjected to thorough clinical history, ENT examinations, laboratory testing, and plain x-ray of the nasopharynx. Data from all patients were obtained by the authors including; age, sex, birth history, presence of passive smoking by the parents, presence of any ENT complaints of the patients (snoring, otalgia, otorrhea, hearing loss) in past history, presence of recurrent upper respiratory tract infections (URTIs), previous ENT operations, e.g., tonsillectomy, and the presence of a family history of atopy and ear disease.

Pulmonary function tests

All participants were informed about maneuvers and were persuaded to practice several times before testing. Vital capacity and flow rates were practiced by spirometry with reference to the American Thoracic Society spirometry criteria (4). The best values of at least three repeated tests after adequate rest were taken. Spirometric tests vital capacity (VC), forced vital capacity (FVC), forced expiratory volume during the first second (FEV1), the ratio of FEV1/FVC, and the peak expiratory flow rate (PEFR) were done for all patients and control group.

Statistical analysis

We used SPSS (version 21, Inc., Chicago, IL, USA) for analysis of patients' data. Categorical data are presented as proportions and continuous data as means ± SD (standard deviations). We used Mann–Whitney and unpaired t-test were used to compare groups; p values <0.05 were considered significant.

Results

In our study, 100 children with adenoid (65 males) and 80 healthy children (48 males) were included. Table1 shows the demographic and lung function parameters in all patients compared to the control group. All spirometric parameters (VC, FEV1, FEV1/FVC, and PEF) were significantly lower in the patient group (Table 1). We compared the results in the adenoid group according to the duration of the disease (Table 2). We found that VC and FEV1 were significantly lower in children with prolonged disease for more than one year.

Parameter	Patients with adenoid (mean ± SD) n = 100	Controls (mean ± SD) n = 80	p-value
Age (years)	7.5 ± 3.7	8.1 ± 2.6	NS
Sex: Male	65 (65%)	48 (60%)	NS
Female	35 (35%)	32 (40%)	NS
VC (L)	1.98 ± 0.59	2.45± 0.68	<0.001
FVC in (L)	1.97 ± 0.76	2.66 ± 0.59	<0.001
FVC ex (L)	1.68 ± 0.79	2.44 ± 0.98	<0.0001
FEV 1 (L)	1.76 ± 0.74	1.99 ± 0.54	<0.001
FEV1/VC (%)	88.8 ± 6.7	81.35 ± 3.5	<0.05
FEV1/ FVC (%)	89.6 ± 8.6	81.3 ± 2.8	<0.001
PEF ((L/ minute)	3.8 ± 0.9	5.47 ± 0.8	<0.05

NS= non-significant, VC: vital capacity, PEF: peak expiratory flow rate, FEV1: forced expiratory volume in 1 second; FVC: forced vital capacity.

Table 1: *Demographic and spirometric findings in patients and control groups.*

Parameter	Less than one year n = 48	More than one year n = 52	p-value
VC (L)	2.03 ± 0.68	1.54 ± 0.54	<0.0001
FVC in (L)	1.57 ± 0.83	1.47 ± 0.66	NS
FVC ex (L)	1.96 ± 0.23	1.89 ± 0.77	NS
FEV 1 (L)	1.85 ± 0.67	1.44 ± 0.81	<0.001
FEV1/VC (%)	88.6 ± 9.3	87.3 ± 0.7	NS
FEV1/FVC (%)	91.1 ± 6.2	93.1 ± 2.4	NS
PEF (L/ minute)	4.2± 0.63	3.7 ± 044	NS

NS= non-significant, VC: vital capacity, PEF: peak expiratory flow rate, FEV1: forced expiratory volume in 1 second; FVC: forced vital capacity.

Table 2: *Comparison between adenoid patients with ≤ one year to patients more than one year.*

Discussion

Adenoid hypertrophy is considered one of the most prevalent pathologies causing upper airway obstruction in the pediatric age group. Adenoid enlargement filling the upper airways may compromise the respiratory flows; however, the patients may not present with any clinical signs [1, 5]. The obstructive upper airway manifestations include many sleeping disorders such as sleep apnea and chronic alveolar hypoventilation. The airflow reduction during respiration is an essential diagnostic tool for the determination of adenoid obstructive complications [6]. Obstruction of the upper airway is the most important indication for adenoid surgery [7]. The assessment of the upper airway by spirometry is one the most important investigations for early diagnosis of the obstructive phenomenon that may not be clinically apparent. The pulmonary function tests are useful tools for the diagnosis of pulmonary disorders as it is non-invasive and highly predictive of the obstructive lung pathology. So, it is advised by many authors for the assessment of adenoid patients [8].

Our results showed that children with adenoid hypertrophy significantly lower spirometric parameters VC, FEV1, FEV1/FVC, and PEF than healthy children. In line with our findings, Maurizi et al., [9] assessed the pulmonary function in children with adenoid hypertrophy, and they found about half of patients (52%) had the features of lower airway obstruction. Also, the study reported that about two-thirds of children with adenoid hypertrophy showed impairment in the pulmonary functions [9]. Aykan et al. [2] reported insignificant correlations between initial FVC, FEV1, forced expiratory flow (25-75), and adenoid hypertrophy in 63 children; however, they found significantly lower FVC (p=0.033) in children with stage 3 and 4 adenoid hypertrophy [2]. Another study [8] found obstructive pulmonary functions in sixty percent of patients with adenoid, which disappeared after the operation. Niedzielska et al. [10] reported that FEV1 stayed unchanged while other pulmonary function values (VC, FEV1/PEF, FEV1/FVC, and PEF) significantly improved after adenoid surgery. Rogha et al. [11] concluded that spirometry in children with adenotonsillar hypertrophy is helpful in evaluating the pulmonary status. Our result showed that VC and FEV1 were significantly lower in children with prolonged symptoms for more than one year. In line with our findings, El-Anwar et al. [1] studied sixty children with adenoid hypertrophy. They found that children adenoid symptoms for two years or more had a statistically significant lower FEV and FEV/ FVC than children with adenoid for less than two years (p<0.0001). They reported that pulmonary functions as a non-invasive tool could be used as a guide for adenoidectomy to prevent the cardio-pulmonary complications of chronic airway obstruction (1).

Conclusion

Prolonged upper airway obstruction due to adenoid hypertrophy may be associated with a decline in pulmonary functions. Spirometry should be added for the assessment of children with adenoid hypertrophy to avoid cardiopulmonary complications.

Conflict of Interest: The authors have no conflict of interest

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