How to Cite:
Jain, A., Jain, M., & Jain, J. (2022). Pulmonary function tests in children with allergic rhinitis. *International Journal of Health Sciences*, *6*(S2), 2364–2370.
https://doi.org/10.53730/ijhs.v6nS2.5546

Pulmonary function tests in children with allergic rhinitis

Ashutosh Jain
Department of Physiology, Index Medical college Hospital and Research Centre, Indore
Email: ashutosh.jain689@gmail.com

Manila Jain
Department of Physiology-Index Medical College Hospital & Research Centre, Indore India

Jaya Jain
Department of Biochemistry, Index Medical College Hospital and Research Centre, Indore

***Abstract*---**Background: Allergic Rhinitis is a chronic and common respiratory disorder due to its prevalence, effect on quality of life, performance at school and work place, economic burden and link with asthma. Pulmonary function tests like FEF (25-75%) and PEFR are impaired in allergic rhinitis Expiratory air flow limitation is the hallmark of physiological change in allergic rhinitis. Aims and Objective: The present study aims to study pulmonary function tests such as FVC, FEF, (25-75%) and PEFR in allergic rhinitis cases to evaluate their predilection to the development of asthma. Materials and Methods: The study was carried out in the Department of Physiology at Index Medical College Hospital and Research Center, Indore, Madhya Pradesh. The study was done on 80 male and female subjects of the age group of 6 to 18 years. Forty male and female subjects suffering from allergic rhinitis attending the Ear, Nose and Throat outpatient department of IMCHRC, Indore were taken as cases. Forty males and females were taken as controls after careful selection as per inclusion and exclusion criteria. PFT was done by Digital Spirometer – Helios 401 manufactured by RMS India. Results: The pulmonary function test like FVC, FEF (25-75%) and PEFR were impaired in allergic rhinitis cases ($P<0.001$) as compared to the controls ($P<0.001$). Conclusion: The results of the present study indicate that allergic rhinitis affects the lung functions. An important mechanism for impairment of PFT in allergic rhinitis could be

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
***Corresponding author**: Jain, A.; Email: ashutosh.jain689@gmail.com*
Manuscript submitted: 27 Jan 2022, Manuscript revised: 18 Feb 2022, Accepted for publication: 09 March 2022

extension of upper respiratory tract inflammation to lower respiratory tract inflammation.

***Keywords*---**allergic rhinitis, pulmonary function test (PFT), forced vital capacity, forced expiratory flow.

Introduction

Allergic Rhinitis is a disease of the nose, resulting from an IgE mediated immunological reaction following exposure to an allergen like dust, pollens etc. In allergic rhinitis there is inflammation of the nasal airways due to irritation of mucosa by allergens (1). Allergic Rhinitis can be counted for more than half of all allergy cases in India affecting every sixth person. All over the world it is one of the more common chronic diseases and it extracts a heavy price both in terms of medical cost and quality of life (1).

Allergic Rhinitis is a major chronic respiratory disease due to its prevalence, effect on quality of life, effect on school performance, work, productivity, economic burden and link with asthma.(1). It is linked with co-morbidities like sinusitis and conjunctivitis. Symptoms of allergic rhinitis include rhinorrhea (free discharge of the nasal mucus), nasal obstruction, nasal itching and sneezing. About 20 - 30% of the Indian population suffers from at least one allergic disease (2). Studies have shown that, A.R. cases are increasing in India, over the past few years (3). Its prevalence in central India is 20 - 26 %.(4).

Approximately 40% of the patients with allergic rhinitis have asthma and 80% of asthmatic patients suffer from persistent nasal symptoms (3). Upper respiratory tract inflammation may extend to lower respiratory tract inflammation which can be assessed by pulmonary function test (PFT). Impairment of pulmonary function test in patients with allergic rhinitis can be considered as a predicative for such cases to develop asthma (5). Impaired Pulmonary function test in allergic rhinitis cases may be considered as the first step of the progression of respiratory allergy towards asthma (5). Pulmonary function test like Forced Vital Capacity (FVC) and Forced Expiratory Flow (FEF) at the 25 and 75 % of the pulmonary volume (FEF 25 -75%) and Peak expiratory flow rate (PEFR) are impaired in patients with allergic rhinitis. The FEF (25-75 %) have been evidenced to be a reliable marker of early bronchial impairment in allergic rhinitis (6).

Spirometery is the most common of the pulmonary function tests measuring lung function, specially the volume or speed of air that can be inhaled and exhaled. Expiratory air flow limitation is the hallmark of physiological change of allergic rhinitis. Pulmonary function tests (PFT) are useful because they are non-invasive and inexpensive, they can be repeated and cause very little discomfort to the patients. Our efforts aims to study Pulmonary Function Tests like FVC, FEF (25-75 %) and PEFR in allergic rhinitis cases to evaluate their predilection to the development of asthma.

Materials and Methods

The study was carried out in the Department of Physiology at Index Medical College Hospital and Research Centre (IMCHRC), Indore, Madhya Pradesh. The study was done on 80 males and females of the age group 6-18 years. Forty males and female children suffering from allergic rhinitis attending the Ear, Nose and Throat outpatient department of IMCHRC, Indore were taken as the cases. Forty healthy males and female children were taken as controls after careful selection as per inclusion and exclusion criteria.

Inclusion criteria

1. Patients diagnosed with allergic rhinitis as case.
2. Age between 6 to 18 years
3. Healthy males and females as control
4. Physically and mentally fit
5. Cooperative and capable of understanding the procedure.
6. Subjects giving consent for study

Exclusion Criteria

1. Patients diagnosed with any other disease like coronary artery disease, Diabetes Mellitus, Liver disease, renal failure, tuberculosis, critical illness, etc;
2. Pregnant women
3. Alcoholics
4. Hyperlipidemia
5. Smokers
6. Tobacco chewers
7. History of long term drug treatment

It is mandatory to get approval from Ethical Committee before commencing the work. A written consent was taken from the patient willing to participate in the study. Invasive procedure was not done.

Grouping of Subjects

Group I A - Males and Females (6 to 18 years) as cases
Group I B – Males and Females (6 to 18 years) as controls

Pulmonary function tests were performed in all the subjects with a computerized Spirometer (Helios 401 manufactured by RMS India. - Helios 401 uses Spiro Excel version 1.1) Height and weight values were added in the software Spiro Esxcel. Add patient details to get the predictive values of different parameters of pulmonary function test.

Procedure of PFT

The subjects were introduced to follow the proper technique, to get best results. They were asked to take deep inspiration and then to exhale in the spirometer as

forcefully and as fast as possible. They have practiced for 2-3 times. After a rest of 5-10 minutes subjects were asked to perform inhalation and exhalation into the pre-medicated spirometery mouth piece connected to the hardware which was linked to computer software. The software converted analog signals and displayed it digitally on the computer screen. They were collected.
Following parameters were recorded.

1. Forced Vital Capacity (FVC): Forced Vital Capacity is the volume of the gas expired forcefully as rapidly as possible after the maximum inspiration. Forced vital capacity is frequently measured clinically as an index of pulmonary function; it gives us useful information about the strength of the respiratory muscles and other aspects of pulmonary function. Normal value of FVC in males is 4.8 liters and in females it is 3.2 liters.
2. Forced Expiratory Flow during 25-75% (FEF):Is the mean expiratory flow rate during the middle 50 % of the forced vital capacity. FEF 25-75 % is normal when it is ≥ 70 %. If the value is ≤ 70 % then it is abnormal (7). It is a sensitive indicator of small airway diseases, where most of the chronic obstructive pulmonary diseases like asthma, emphysema.
3. Peak Expiratory Flow Rate (PEFR)
   Peak Expiratory Flow rate is defined as highest rate at which the air can be expiated after a deep inspiration (7). It is the expiratory flow rate during the peak of FVC. More than 70% is normal and less than 70% is abnormal.

Statistical Analysis

The software we used was SPSS version 2

Results

The mean FVC value in group 1A was 69.4±11.1 and in group 1B 98.8±12.7; The FVC value in allergic rhinitis (A.R.) cases was decreased as compared to controls We determined from the “Z” test that difference of FVC between group 1-A and 1-B was statistically highly significant. (“Z” value is 11.04 and “P” value is 0.000.)

The mean FEF (25-75%) value in group 1-A was 65.2±5.6 and in group 1-B was 113.9±21.9, FEF (25-75%) is a best indicator of small airway disease. There is a reduction in FEF (25-75%) in the cases of allergic rhinitis as compared to controls. As evaluated by “Z” test, the difference of FEF (25-75%) between these two groups was highly significant (“Z” value is 13.76 and P value is 0.000). The mean PEFR % in group 1-A was 66.6±5.7 and in group 1-B it was 96.6±14.3. The PEFR % is reduced in allergic rhinitis cases as compared to controls. From the results of “Z” test it is clearly evident for the group 1-A and 1-B the difference of PEFR value was highly significant (“Z” value 12.95 and “P” value is 0.000).

Table I

Traits	Group 1-A cases	Group 1-B controls	"Z" value	"P" value	Significant/N.S.
Mean FVC %	69.4±11.1	98.8±12.7	11.04	0.000	Highly Significant
Mean FEF 25-75 %	65.2±4.7	113.9±21.9	13.76	0.000	Highly Significant
Mean PEFR %	66.6±5.7	96.6±14.3	12.35	0.000	Highly Significant

P<0.05 P=0.05 Significant, P<0.001 or P=0.000 highly significant.

Discussion

Allergy is not a disease but it is a mechanism leading to disease. Allergic Rhinitis (A.R.) affects up to 40 % of the population in the world. The presence of eosinophilia in A.R. has been long established. Allergic Rhinitis affects pulmonary function tests (5). Chronic or untreated A R may result in complications, which includes re-current chronic sinusitis, formation of nasal polyps, etc. and may lead to asthma.

While allergy refers to an inflammatory process of upper respiratory tract, symptoms may extend to affect eyes, ears, sinuses and lungs. A.R. is a global health problem. In addition to appropriate treatment, symptom recognition is important in managing and reducing morbidity in this increasing prevalent disease. (8). In the present study the mean forced vital capacity in group 1-A was 69.4±11.1 and in group 1-B was 98.8±12.7. The forced vital capacity is decreased in allergic rhinitis cases compared to controls. (Z= 11.04 and P =0.000)

In our study the mean forced expiratory flow rate (25-75%) in group 1-A was 65.75±5.6 and in group 1-B was 113.9±21.9. The FEF (25-75 %) is significantly decreased in allergic rhinitis cases as compared to control (Z=13.76, P=0.000) In present study we evaluated peak expiratory flow rate. The mean PEFR in group 1-A was 66.6±5.7 and in group 1-B was 96.6±14.3. The PEFR is significantly reduced in allergic rhinitis cases as compared to controls. (Z=1.35 and P=0.000). It has been determined that 40 % cases with allergic rhinitis have contracted asthma and 80 % of asthma cases have allergic rhinitis (9).

The main observation in those cases is that, the cases having upper respiratory tract inflammation may extend to lower respiratory tract; it is evaluated by pulmonary function tests. Impaired PFT in patients with A R is considered as predictive for such cases to progress to develop asthma (5). It is advisable to screen the patients of A.R. for PFT, A slight impairment in FEF (25-75%) and PEFR could be a marker for the onset of asthma. In our study there was a reduction in FEF (25-75%) and PEFR which could be of help to educate people for risk of asthma. The FEF (25-75%) is a trustable marker of early stage bronchial impairment in allergic rhinitis (5).

Spiro metric changes in the pulmonary function are the first indicators of airway obstruction and small airway diseases. FEF (25-75%) < 70 % predicated is an abnormal PFT. This value is an important marker of airway obstruction. Ciprandi et. al. (5), Yousser et. al. (10) Nevine et. al. found that alteration and reduction in FEF 25-75 % and PEFR signifies inflammation of airways. Ciprandi et. al. (5) found that 87 % of the patients of A.R. had a reduction in FEF (25-75%) In our study we found a remarkable reduction in FEF (25-75%) and PEFR.

Marseglia et. al. found impairment of PFT in allergic rhinitis cases. They stated that a closed link is present between A.R. and asthma. In small airway diseases there is reduction in FEF (25-75%) and PEFR. In our study there was statistically significant reduction in FEF 25-75 (25-75%) and PEFR and our results match with that study. Therefore A R becomes a key factor for advancement of Asthma. Nevine et. al.(11), Corolin et. al. (12), found that there is increase in the percentage A.R. and asthma. The reduction was found in FEF (25-75 %) and PEFR, Allergic Rhinitis is a risk factor for asthma. A.R. may increase the underlying asthma and makes the bad to worse the PFT. Allergic Rhinitis and asthma share common inflammatory process and predisposing genetic factors.

Reduction in FEF (25-75%) and PEFR signifies inflammation of the airways and indicates early stage of bronchial impairment. Angela Pistorio et.al(13). studied PFT in allergic rhinitis cases. They stated that A.R. is an inflammation of the upper airway and asthma is a chronic inflammation of lower airway. The allergic upper airway inflammation causes airflow limitation at nasal and bronchial level. So A R becomes a strong link for asthma. It is advisable to screen the patients of A R for PFT. An impairment in FEF (25-75%) and PEFR could be a marker for the onset of asthma.

Conclusion

The results of present study indicated that in allergic rhinitis there is impairment in pulmonary function test. There is a reduction in FEF (25-75%) and PEFR in allergic rhinitis cases as compared to controls. Reduction in FEF (25-75%) and PEFR signifies inflammation of the airways.

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