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Original article

Correlation of Height Parameter and Pulmonary Function Test with Grade of Allergic Rhinitis and Asthma in Children

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Abstract

Introduction: Allergic Rhinitis and Asthma adversely affects height in children and it could be considered as an objective tool to assess severity, compliance and lung functions in children. We studied the correlation between height and pulmonary function tests with classification of allergic rhinitis and asthma. ***Aims & Objectives:*** 1) To study the height parameter with the grade of asthma and allergic rhinitis 2) To evaluate the pulmonary function test with the severity of asthma and allergic rhinitis 3) To correlate height and pulmonary function test with the classification of asthma and allergic rhinitis. ***Material and Methods:*** A prospective study including 30 patients in the age group of 5-12 years diagnosed with allergic rhinitis (AR) and bronchial asthma was conducted in a private tertiary care hospital in Navi Mumbai. History was entered in a pre-designed proforma and height was measured using a calibrated stadiometer along with pulmonary function tests recorded at the initial and two visits, 3 months apart. ***Results:*** Height increased significantly in patients without AR (p-value<0.01), with mild intermittent (p-value=0.02) and mild persistent AR (p-value<0.01) on subsequent visits. Patients with intermittent, mild persistent and moderate persistent asthma showed a statistically significant increase in height (p-value<0.01) with subsequent assessments. No significant increase in height was noted in patients with moderate persistent AR (p-value=0.14) and severe persistent asthma (p-value=0.16). At baseline, the height correlated significantly with FEV1 (p value<0.01), FVC (p value<0.01), Pre and Post-PEFR (p value<0.01, each). This trend continued at the first follow up. At the second follow-up, height correlated significantly with all parameters of pulmonary function tests (p value<0.01 for FEV1, FVC, FEV1/FVC ratio and PEFR). ***Conclusion:*** Height correlation with classification of AR and Asthma along with pulmonary function test has emerged as a simple, safe, cost-effective method in assessing control and monitoring the disease.

Keywords: ***Allergic Rhinitis, Bronchial Asthma, Height, Pulmonary Function Test, Paediatrics***

Introduction

The quality of life for children with Allergic rhinitis (AR) and Asthma is vital for the child's wellbeing and preventing school absenteeism. Asthma and Allergic rhinitis in children is a syndrome complex which affects daily activities, sleep, play, work and school activities. Growth with special reference to height is one such parameter which is immensely affected if the disease is not graded and treated appropriately in a time bound manner. The prevalence of childhood Asthma in a developing country like India, according to various studies ranges from 3.5 % to 29.5% [1].

Spirometry is the preferred method for the diagnosis of obstruction. Airflow obstruction is defined as Forced expiratory volume (FEV1) of less than 80% predicted and a reduced FEV1/ Forced vital capacity (FVC) ratio of less than 0.8. Significant reversibility after administration of a short-acting bronchodilator is typically seen in asthma and is indicated by an increase in FEV1 of ≥12% from baseline. Allergic rhinitis (AR) is invariably associated with asthma in children and the prevalence of AR is 14.6% in the adolescent age group [2]. The classical diagnostic features include rhinorrhoea, nasal obstruction, sneezing and nasal itching.

Asthma and AR are classified as one airway one disease as proven by the strong epidemiological correlation between the two [3]. Both conditions are diseases of respiratory tract mucosa, linked by common immunological processes, and they respond to similar treatments.

Majority of the patients have a combination of AR with Asthma, and with each episode of AR, there is an acute exacerbation of Asthma and subsequently improvement in asthma control once the rhinitis component is treated [4]. In the recent past, nutritional status, growth parameters and the course of the disease associated with Asthma has gained a lot of attention [5,6,7]. There is a paucity of studies on the correlation of height and allergic rhinitis with asthma in children. Hence, we decided to study the height parameter of children with allergic rhinitis and asthma of varying grades along with pulmonary function tests. Height and pulmonary function tests being objective parameters would ensure control and compliance of these children with its simplicity and cost-effectiveness.

Materials and Methods

It was a prospective study conducted in the Department of Paediatrics of a private tertiary care hospital, from September 2016 to March 2018. The study was approved by the institutional ethical committee. Informed consent and assent was taken from parents and children who satisfied the inclusion criteria. A self-constructed semi-structural case record form was used to record the demographic details, clinical symptoms and signs. Pulmonary Function Test (PFT) parameters included FEV1, FVC, FEV1/FVC, and Peak Expiratory Flow Rate (PEFR). The study included 30 consecutive patients diagnosed with allergic rhinitis and bronchial asthma.

Inclusion Criteria

1. Age between 5 to 12 years of both sexes.
2. Patients diagnosed with Bronchial Asthma (Global Initiative for Asthma: GINA guidelines) and Allergic Rhinitis (Allergic Rhinitis and its impact on Asthma: ARIA guidelines).
3. Parents/children who have given the consent /assent.

Exclusion Criteria

1. Presence of upper and lower respiratory tract infection in the past four weeks.
2. Presence of an acute exacerbation, emergency visit, or hospitalization during the past four weeks.
3. Presence of skeletal disorders with asthma and allergic rhinitis.
4. Parents who have not given their consent.

Measurement of Anthropometry

On enrolment of subjects, demographic details and a brief history were noted in the case record form. Height was recorded by asking the patients to remove their shoes, stand against a calibrated stadiometer, their bare feet touching each other, with heel, calf, buttock, upper back, and occiput touching the wall and child looking straight ahead. A baseline height was recorded at the first visit and then on subsequent 2nd and 3rd visits.

Pulmonary Function Testing

Pulmonary function was assessed with a computerized spirometer (Medical International Research: MIR Spirobank G spirometer) and was performed following the protocol by American Thoracic Society [8]. FVC, FEV1 and FEV1/FVC were measured three times, the best trial being recorded. All parameters were reported as percent of the predicted for age, height, and gender [9]. PEFR was measured using a portable Peak Flow Monitor (Breath-O-Meter). Three successive expiratory manoeuvres were performed, and the one with the highest value was recorded. The result was reported as a percentage of the predicted for age, height and gender [10].

Statistical Analysis

Descriptive variables were expressed as mean and standard deviation for quantitative variables while for qualitative variables it was in frequency and percentages. The Chi-square test and the Student's t test or the Mann-Whitney U test were used for testing differences among categorical and continuous variables along with the standard method of ANOVA. The correlation between any two parameters between the groups or within the same group was made by using Pearson's correlation coefficient. The statistical analysis was done with SPSS Version 21.0 (IBM Corp, NY) and p value less than 0.05 was taken as statistically significant.

Observations and Results

The observed age group was 8 to 10 years (43.3%) and more than 10 years (33.3%). Mean age of the patients was 9.1 ± 2.02 years with (33.3%) females and (66.7%) males. (Table 1). Classification of asthma revealed mild persistent (43.3%); intermittent (26.7%); moderate persistent (20%) and severe persistent (10%). (Table 2).

Classification of AR grading revealed mild intermittent and mild persistent (23.3%) each with moderate persistent (13.3%) (Table 3). Height was measured at baseline and two follows ups three months apart. Patients with intermittent asthma had mean height of 137.75 ± 14.95 cm at baseline, which increased significantly to 139 ± 14.40 cm at first follow up (p value <0.01) and 140.50 ± 14.31 at second follow up. Patients with mild persistent asthma had mean height of 133.46 ± 14.45 cm at baseline, which increased to 136.08 ± 13.50 cm and to 138 ± 14.15 cm at first and second follow up respectively. Patients with moderate persistent asthma had mean height of 136.50 ± 8.14 cm at baseline, which increased to 138.83 ± 7.52 cm and to 141.00 ± 8.56 cm at first and second follow up respectively. Patients with severe asthma had mean height of 124.67 ± 9.24 cm at baseline, 126.67 ± 11.02 at first follow up and 127.67 ± 11.85 at second follow up. Significant increment in the height of intermittent, mild persistent and moderate persistent asthma was observed but not in the severe persistent type (Graph 1).

There was a significant increment in height of patients with mild intermittent and mild persistent allergic rhinitis. There was an increase in mean height in moderate persistent allergic rhinitis which was not statistically significant (p value-0.14) (Graph 2). The baseline and first follow-up height correlated significantly with FEV1 (forced expiratory volume in one minute), FVC (forced vital capacity), Pre and Post PEFR (Peak Expiratory Flow rate) but not the FEV1/FVC ratio.

However, the second follow up revealed significant correlation of height with all the four parameters of pulmonary function test (FEV1, FVC, FEV1/FVC, PEFR). (Table 4).

Table 1: Distribution of Patients According to their Gender

Gender	N	%
Female	10	33.3%
Male	20	66.7%
Total	30	100.0%

Table 2: Distribution of Patients According to their Severity of Bronchial Asthma

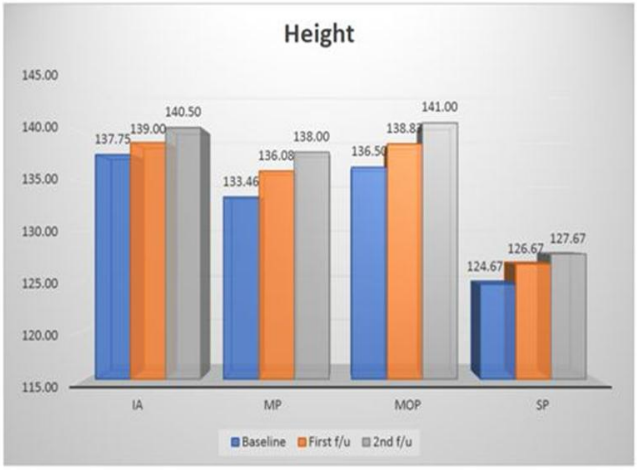
Asthma Grade	N	%
Intermittent Asthma	8	26.7%
Mild persistent	13	43.3%
Moderate persistent	6	20.0%
Severe persistent	3	10.0%
Total	30	100.0%

Table 3: Distribution of Patients According to their Severity of Allergic Rhinitis

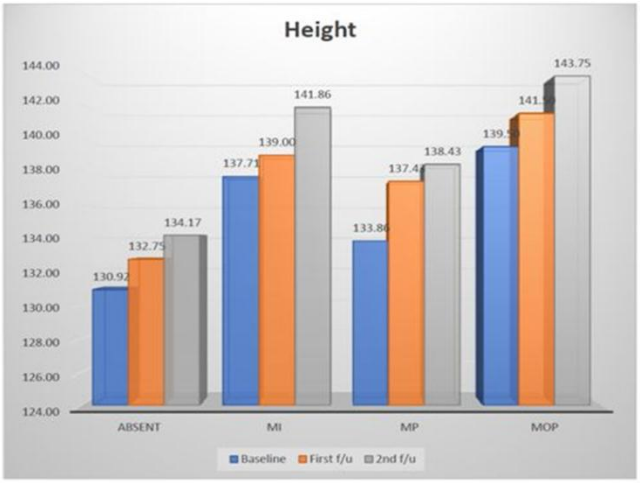
Allergic Rhinitis Grade	N	%
Absent	12	40.0%
Mild intermittent	7	23.3%
Mild persistent	7	23.3%
Moderate persistent	4	13.3%
Total	30	100.0%

Table 4: Correlation of Height with Various Parameters of Pulmonary Function Test at Different Follow-up visits

Pearson co-relation		
Height (Baseline)	r value	p- value
FEV1	0.89	<0.01
FVC	0.86	<0.01
FEV1/ FVC	0.09	0.65
Pre PEFR	0.74	<0.01
Post PEFR	0.86	<0.01
Height (1st follow up)		
FEV1	0.86	<0.01
FVC	0.82	<0.01
FEV1/ FVC	-0.14	0.45
Pre PEFR	0.65	<0.01
Post PEFR	0.76	<0.01
Height (2nd follow up)		
FEV1	0.77	<0.01
FVC	0.71	<0.01
FEV1/ FVC	0.17	<0.01
Pre PEFR	0.68	<0.01
Post PEFR	0.66	<0.01



GRAPH 1: Comparing Mean Height of Patients with Different Asthma Severity at Different Follow-up visits



Graph 2: Comparing Mean Height of Patients with Different Severities of Allergic Rhinitis at Different Follow-up visits

Discussion

Majority of the patients were in the age group of 8 to 10 years, followed by 10 to 12 years and 5 to 7 years. Male preponderance was seen in our study as reported by Naik et al who found higher prevalence of asthma in males (3.3%) compared to females (2.9%) [11]. Anuradha et al, showed male dominance in (71.66%) [12]. Horwood et al observed that the prevalence of asthma is nearly twice in boys than girls before the age of 14 [13].

Allergic rhinitis has emerged as a major risk factor associated with development of Bronchial Asthma in children and their association has been widely studied [14].

A significant increase in mean height was observed in children with mild intermittent, mild persistent AR and those without the AR component. However; the subjects with moderate AR severity showed insignificant change in height parameter.

The severe persistent asthmatics constituted only 10 % of the patients who did not show any increase in the height parameter. Higher doses of inhaled corticosteroids and poor compliance may account for diminished increase in height velocity. The height in children is positively influenced by the synthesis of somatotropin in response to physical training and subsequently cause height affection in severe asthmatics as they are unable to perform various sports activities [15].

There was a significant correlation between height and Pulmonary function tests (FEV1, FVC, PEFR) on the first follow-up ; however on second visit , all the parameters of PFT (FEV1,

FVC, FEV1/FVC AND PEFR) showed noteworthy statistical correlation.

The positive correlation of height with PFT probably makes the height of asthmatic and allergic patients a good prognostic indicator for assessing compliance and disease control. The anthropometric measurements of weight, height, hip circumference and body surface area have been found to be positively correlated to the pulmonary function tests [16,17]. Nystad et al. prepared a linear regression model which showed that standing height was a satisfactory predictor of lung function and the explained fraction of variance (R2) was 59% for FEV1 [18]. Hence our study revealed that height parameter probably aids in identifying the compliance to treatment and serves as a good prognostic indicator. There was an inverse correlation between significant increase in height and severity of AR and asthma in our subjects.

As observed in one of the study, an increase in asthma severity was associated with reduction in height parameter and the patients with lower grade of asthma classification did not show any significant change as compared to their healthy peers [19].

Conclusion

Children with allergic rhinitis and bronchial asthma exhibit height as a distinctive parameter for growth, compliance, daily activities, grading and prognosis. Height parameter may be proposed as an objective, simple, safe, and cost-effective tool for assessment of growth and lung functions amongst AR and asthmatic children.

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Conflict of interest: NIL

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