Original Research Article

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Peak expiratory flow rate assessment to screen for asthma in children with allergic rhinitis

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ABSTRACT

Background: Allergic rhinitis is a common disease affecting around 10-25% of the population worldwide. There is a temporal relationship between the onset of allergic rhinitis and asthma and the 'unified airway hypothesis' explains this. Many researchers have demonstrated bronchial hyper-responsiveness prior to onset of asthma symptoms further validating this hypothesis. Further many studies favour treating allergic rhinitis may prevent the onset of asthma. So, detecting allergic rhinitis earlier and treating it adequately is of vital importance. The aims and objectives of this study is to identify bronchial hyper responsiveness in children with allergic rhinitis, prior to the onset of asthmatic symptoms, by measuring PEFR and its clinical correlates.

Methods: A prospective observational study was conducted in Department of Paediatrics in Sree Balaji Medical College and Hospital. Inclusion and Exclusion Criteria were defined, and the study was conducted on a total of 85 children. After taking informed consent from parents, the children coming under the study population were analyzed for their baseline characteristics and PEFR is measured using a low reading Mini Wright peak flow meter and compared with mean value of south Indian children using the formula, PEFR= {(HEIGHT IN CM-100) X5} +100.

Results: The mean PEFR as expressed in percentage of expected PEFR is 77.28% in males and 83.34% in females. The mean percentage of expressed PEFR does not vary significantly between different age groups. Of the 85 children,48(56.5%) have mild intermittent allergic rhinitis,28(32.9%) have mild persistent allergic rhinitis,5(5.9%) have moderate-severe intermittent allergic rhinitis and 4(4.7%) have moderate-severe persistent allergic rhinitis. There were 37(43.5%) blockers (with predominant nose block) and 48(56.5%) runners (with predominant rhinorrhea). **Conclusions:** PEFR is abnormal in 41.2% of children with allergic rhinitis. PEFR reduces linearly as the severity of allergic rhinitis increases. PEFR decreases as the number of cardinal symptoms increases. PEFR increases significantly after treatment of allergic rhinitis alone.

Keywords: Allergic rhinitis, Asthma screening, Peak expiratory flow rate

INTRODUCTION

Allergic rhinitis represents a global health problem affecting 3-40% of population worldwide. It is a chronic inflammatory disease induced by an IgE-mediated reaction in response to allergen exposure in the nasal mucosa. It is now clear from a large number of cross sectional studies that allergic rhinitis is strongly

associated to asthma.¹ These studies have demonstrated that impairment and dysfunction of the upper and lower airways frequently occur together and appear to share common risk factors such as atopy common inflammatory mediators common defence mechanisms and common nervous control.²⁻⁵ Allergic rhinitis developing in the first years of life is an early manifestation of an atopic predisposition, which may be

triggered by early environmental exposures. Allergic rhinitis and that positive allergy skin tests are significant risk factors developing asthma. Patients with either perennial or seasonal allergic rhinitis are three times more likely to develop asthma than negative controls.^{4,5}

Bronchial hyperresponsiveness (BHR) sometimes referred to as airway hyperresponsiveness is the occurrence of excessive bronchoconstriction in response to a variety of inhaled stimuli, both chemical and physical.^{6,7} BHR is regarded as a 'hallmark', a 'defining feature' and the 'most characteristic clinical feature' of asthma. However, is often detected in atopic individuals, in patients with rhinitis but without pulmonary symptoms. Several cross-sectional studies have shown that BHR was increased in subjects with allergic rhinitis.⁸⁻¹⁰

At this point we can establish beyond doubt the existence of relationship between allergic rhinitis, asthma and Bronchial Hyperresponsiveness (BHR). Many researchers have demonstrated Bronchial Hyper responsiveness prior to the onset of asthma symptoms, in support to our hypothesis. 11,12

Many studies favour the view that treating allergic rhinitis may prevent the onset of asthma. ^{13,14} So detecting and treating allergic rhinitis is of vital importance to prevent future development of asthma. The methacholine challenge test which is used in predominantly in studies to determine Bronchial Hyper-Responsiveness is not available in many centres and not feasible for day to day use in clinic. The ease of performance and lack of invasiveness made the measurements of peak expiratory flow rate, one of the most commonly used measures of Bronchial Hyper-Responsiveness. ^{15,16}

This current study primarily aims at finding the usefulness of peak expiratory flow rate determination as an early marker of Bronchial Hyper-Responsiveness in children with allergic rhinitis and secondarily to determine the effect of treatment of allergic rhinitis on Bronchial Hyper-Responsiveness.

METHODS

It is a prospective observational study conducted from May 2017 to Feb 2018 in General outpatient department and allergy clinic outpatient department in Sree Balaji Medical college and hospital.

All children coming under the study population after meeting inclusion and exclusion criteria were analyzed for their baseline characteristics and PEFR is measured using a low reading mini wright peak flow meter and compared with mean value of south Indian children using the formula, PEFR= {(HEIGHT IN CM-100) X5}+100.¹⁷ At the end of the study, the results are tabulated. The PEFR values are grouped in various clinical parameters like Age, Sex, ARIA classification, Cardinal

symptoms, Serum IgE levels and Absolute eosinophil count.

The variation in PEFR among the different groups are analysed using the unpaired t test and one-way ANOVA test. The changes in PEFR after treatment of allergic rhinitis is determined. The difference after treatment is statistically analysed using paired t test. Statistical significance was taken as p < 0.05.

RESULTS

The inclusion criteria were met in 142 children among 1145 children. The prevalence of allergic rhinitis was 12.4%. 7 children were not included in this study as they could not be trained to use the peak flow meter effectively.38 children (26.8%) were excluded as they have symptoms of asthma.7 children had tachypnea of other causes and could not be included in this study.3 children received oral steroids in the preceding 2 months and hence were excluded. So, the remaining 85 children were analysed.

Of the 85 children 35 (41.2%) were females and 50 (58.8%) were males. Male to Female ratio is 1.4 to 1. The mean peak expiratory flow rate as expressed in percentage of expected PEFR is 77.28% in males and 83.34% in females. Using unpaired t test the difference between these values is not significant, 2 tailed p value is 0.1085 as shown in Table 1.

Table 1: Gender and PEFR.

Gender distribution	Number	%	Mean % of expected PEFR
Male	35	41.2	77.28%
Female	50	58.8	83.34%
2 tailed p value=0.1085			

2 tailed p value=0.1085

More number of children are present in the 6 to 9 age group. The mean percentage of Peak Expiratory flow rate (PEFR) does not vary significantly between different age groups.

This was analysed by one-way ANOVA and the p value is 0.2 which is not significant as shown in Table 2.

Table 2: Age Distribution and PEFR.

Age Group (in years)	No.	Mean % of expected PEFR
5-9	57	80.6
10-13	24	81.2
>14	04	81.6

p value by one-way ANOVA test is 0.20

Of the 85 children, 48 (56.5%) have mild intermittent allergic rhinitis, 28 (32.9%) have mild persistent allergic

rhinitis, 5 (5.9%) have moderate-severe intermittent rhinitis and 4(4.7%) have moderate-severe persistent allergic rhinitis. The number of children with abnormal

PEFR (<80% of expected) also increases significantly as the severity of allergic rhinitis increases as shown in Table 3.

Table 3: ARIA classification types, PEFR and severity of allergic rhinitis.

Class	>80%	60-80%	<60%	%abnormal	Mean % of expected PEFR
Mild intermittent	34	131	0	29.2	89
Mild persistent	15	10	3	46.4	79
Severe intermittent 1	•	1	3	80	63
Severe persistent	0	1	3	100	57
Total	50	25	10	41.2	

P value by one-way ANOVA test is <0.0001

There were 37(43 %) blockers (with predominant nose block) and 48(56.5%) runners (with predominant rhinorrhea). 56 (65.9%) children had 2 cardinal symptoms; 16 (18%) had 3,10 (11.8%) had4 and 3 (3.5%) had all the 5 cardinal symptoms.

Table 4: Cardinal symptoms.

Cardinal symptoms	No. of children	p value	Mean % of expected PEFR
Rhinorrhoea	60	0.29	81
Sneezing	72	0.70	80
Nose Block	37	0.006	77
Nose Itch	33	0.09	78
Conjuctivitis	10	0.06	70

P value by one-way ANOVA is 0.13

The mean percentage of expected PEFR decreases as the number of cardinal symptoms increases. The p value by one-way ANOVA is 0.04, which is significant. Except for nose block, the presence of other cardinal symptoms did not significantly affect the mean percentage of expected PEFR.

Table 5: No. of Cardinal Symptoms and PEFR.

No. of cardinal symptoms	Mean % of expected PEFR
2	82
3	78
4	70
5	69

P value by one-way ANOVA is 0.04

Analysis was done with unpaired t test and the 2 tailed p value. The variation in mean percentage of expected PEFR among the 5 cardinal symptom groups is not significant. The p value by one-way ANOVA is 0.1362, as shown in Table 4.

The total serum IgE levels are normal in 50(58.8%) and high in 35(41.2%) children. The total serum IgE level

increases with increasing severity with a p value of 0.0003, which is extremely significant. There is no correlation between serum IgE levels and mean percentage of expected PEFR values (p value is 0.9) as shown in Table 6.

Table 6: Serum IgE Levels and PEFR.

Туре	Normal level	High Level	Mean IgE	P value
Mild intermittent	16	32	234	
Mild Persistent	12	16	312	
Severe intermittent	5	0	604	0.0002
Severe Persistent	2	2	842	0.0003
Total	35	50	313	
Mean % of expected PEFR	80.6	80.2	-	

P value is 0.9

The Absolute Eosinophil count is high in 33 (38.8%) and normal in 52 (61.2%) children. Though the Absolute Eosinophil count increases with increasing severity, the p value determined by one-way ANOVA is 0.1097 which is not significant.

Table 7: Absolute eosinophil count and severity of allergic rhinitis.

Туре	Normal level	High level	Mean AEC	P value
Mild intermittent	15	33	259	
Mild persistent	12	16	279	
Severe intermittent	3	2	458	0.1097
Severe persistent	3	1	484	0.1097
Total	33	52	288	
Mean % of expected PEFR	83.6	76.6		

P value by unpaired t test is 0.0662

The mean percentage of expected PEFR is 76.6% when AEC is high and 83.6% when AEC is normal. The difference between the two is statistically not quite significant. The 2 tailed p value by unpaired t test is 0.0662 as shown in Table 7.

Table 8: Effect of treatment of allergic rhinitis and PEFR Mean % PEFR.

No.	Pre-treatment	Post-treatment
1	42	79
2	43	81
3	44	79
4	49	97
5	49	98
6	57	95
7	55	89
8	50	91
9	51	87
10	49	89
11	44	87
12	56	89
13	49	88
14	51	90
15	50	91
16	49	88
17	52	87
18	53	88
19	47	90
20	47	91
21	50	89
22	52	90
23	53	91
24	55	88
25	50	89
26	51	88
27	52	92
28	50	92

The initial PEFR was abnormal in 35(41.2%) children. These children are followed up after 2 weeks of treatment of allergic rhinitis according to ARIA recommendations. 7 cases did not turn up. The remaining 28 cases were again tested for PEFR. There is an improvement in PEFR in all cases. The p value by paired t test is <0.0001 which is statistically extremely significant.

DISCUSSION

The incidence of allergic rhinitis is increasing globally and should be considered as an important event in atopic March, further validating the theory of treating allergic rhinitis completely to prevent development of asthma in later stages of life in children. The incidence in our institute while conducting this study is 12.4% among the general out patients. This correlates well with the incidence in India which is 10% by the ISAAC study.¹⁷

The prevalence of asthma in allergic rhinitis in this study is 26.8%/ which correlates well with 10 to 40% from other studies. ¹⁸⁻²⁰ In the present study ,58.8% were males and 41.2% were females, with a male to female ratio of 1.4:1. This correlates with SAPALDIA cross sectional study with a sex ratio of 1.13:1. ²¹ There is no sex predilection for PEFR in patients with allergic rhinitis in this study. In this study, the peak age for allergic rhinitis peaks in the age group of 7 to 10 years, which concurs with 8 to 10 years peak age onset from a study by O'Connell. ²²

In the present study, the incidence of BHR is 41.2% which correlates well with the studies done by Shaaban et al, Modrzynski et al, Cibella et al, Mete et al, Prieto et al and Braman et al.²³⁻²⁸ All the above-mentioned studies, challenge with methacholine, histamine or pollen was used along with spirometry. All these are meant for research purposes and are difficult to implent in a clinical set up. The ease of performance and lack of invasiveness have made the measurements of PEFR one of the most commonly used measures of BHR, and this study's results assert the same. It can be concluded from this study that presence of BHR and concomitant atopic manifestations in childhood increase the risk of developing asthma and should be recognized as a marker of prognostic significance, whereas the absence of these manifestations predicts a very low risk of future asthma.

On the basis of new ARIA classification, a retrospective study in nine countries showed that intermittent rhinitis was observed in less than 20% of patients, whereas persistent rhinitis comprised approximately 80%.²⁹ In present study, intermittent rhinitis was seen in 62.4% and persistent rhinitis was observed in 37.6%. These findings are exactly opposite to the findings in other studies. This is mainly because of the strict inclusion and exclusion criteria. In this present study, PEFR in perennial allergic rhinitis is lower than the seasonal (75.5 vs 83.4%) and the difference is statistically not significant (p=0.12) which is contrary to the findings by Leynaert et al and Riccioni et al prior to the development of ARIA gidelines.^{30,31} But since PEFR correlates well(p=0.001) with severity as determined by the ARIA classification, it is suggested that the ARIA classification should be used for classifying allergic rhinitis.

In the classic study by wang et al, the prevalence of at least one, two, three or four nasalsymptoms on most days during the past year was 25.5%, 13.1%, 6.5% and 3%, respectively. In this present study, the prevalence of two, three, four and five cardinal symptoms are 12.4%, 4.2%, 1.9% and 0.4% respectively. 56 (65.9%) children had two cardinal symptoms, 16 (18.8%) had three, 10 (11.8%) had four and 3 (3.5%) had all five cardinal symptoms and its proven that more the number of cardinal symptoms, lower is the PEFR. In the study by Wang et al, the prevalence of any individual nasal symptoms (sneezing, rhinorrhea, itchy nose and nasal blockage) was 48.6%, 45.9%, 41.6% and 40.0%, respectively.³² In present

study, sneezing is the commonest symptom and conjunctivitis is the least common symptom. In present study, sneezing is present in 84.7%, rhinorrhea in 70.6%, nose block in 43.5%, nose itch in 38.8% and conjunctivitis in 11.8% which correlates well with study by Demoly et al and more significantly, nose blockers had a significantly low PEFR in this study. This finding has not been made out from an extensive literature search in any of the studies.

In the present study there is extremely significant (p<0.0001) improvement in PEFR following treatment of allergic rhinitis alone, which is in unison with other studies. In the present study, all the therapeutic modalities including allergen avoidance, cetrizine and nasal steroids were used for treating children as per the ARIA criteria, the observation of improved BHR with treatment of allergic rhinitis alone is very important , as this suggests a halt in march of the disease to overt asthma.

CONCLUSION

PEFR is abnormal in 41.2% of children with allergic rhinitis. PEFR reduces linearly as the severity of allergic rhinitis increases. PEFR decreases as the number of cardinal symptoms increases. **PEFR** increases significantly after treatment of allergic rhinitis alone. It is necessary to look for asthma in patients suffering from allergic rhinitis. It is suggested that peak expiratory flow rate monitoring, which is simple, safe, low cost and objective bedside clinical tool should be performed in children with allergic rhinitis >5 years of age. Knowledge of this approach is of utmost importance for general practitioners, allergists, and ENT specialists because diagnostic delay will result in unsatisfactory treatment of the disease. The high risk children thus identified, when treated adequately for allergic rhinitis, would prevent the future occurrence of asthma.

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Institutional Ethics Committee

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