Section: Pediatrics

Original Research Article

A COMPARISON BETWEEN PEFR AND FEV1 IN CHILDREN WITH BRONCHIAL ASTHMA ATTENDING A TERTIARY CARE CENTRE IN KERALA

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Abstract

Background: Bronchial Asthma, is assessed by the tools Spirometry and peak expiratory flow rate (PEFR) where FEV1 (Forced Expiratory Volume in one second) is considered the gold standard. PEFR, a simpler tool with a chance of over or underestimation. As PEFR is routinely used in a resource limited OP setting, it is important to investigate further to see if the changes in PEFR are similar to those estimated by FEV1. This study aims to compare the effectiveness of PEFR and FEV1 in monitoring the children with bronchial asthma. **Materials and Methods:** A descriptive diagnostic test evaluation was conducted in 199 children with bronchial asthma aged 7-14 years attending the Paediatric asthma clinic at Government Medical College Ernakulam over a period of 1 year. Peak expiratory flow rate and FEV1 were measured for each subject during two visits 4 weeks apart and any change in the values were recorded as percentages. A difference of 20% or more in PEFR and 12% in FEV1 was considered significant. **Result:** A positive correlation was noted between the mean values of PEFR & FEV1 (r - 0.9) and the percent change in PEFR and FEV1 (r - 0.25) in this study. The sensitivity and specificity of PEFR were found to be 26.9% and 83% respectively. Mcnemar test showed significant result with p value of 0.03. **Conclusion:** According to our study, PEFR has a low sensitivity in assessing treatment response in bronchial asthma compared to FEV1. Hence, we conclude that PEFR results will have to be correlated with spirometry results while monitoring children with asthma & adjusting treatment dose.

INTRODUCTION

Asthma is a heterogeneous disease, which begins in childhood in 50% cases. It is usually characterized by chronic airway inflammation., Asthma incidence among children is rising in developing countries, including India where it affects approximately 6% of individuals in the 6-20 years' age group.[1]

According to the GINA guidelines,[2] bronchial asthma is diagnosed based on the following criteria -

1. Classic symptoms such as cough, breathlessness, and wheeze, which worsen in the early morning or night, and are aggravated by exposure to risk factors.
2. Presence of variable expiratory airflow limitation, which is measurable by PEFR. A PEFR variability exceeding 13% is indicative of bronchial asthma. Another hallmark feature is reversibility with bronchodilators.

Key parameters often evaluated in diagnosing asthma include symptoms and variability in airflow limitation; however, relying solely on clinical symptoms and peak expiratory flow may result in a high likelihood of missing airflow obstruction.[3-5] Spirometry offers an objective assessment of airflow limitation and is widely accepted as the gold standard for diagnosis.[6-8] This involves the accurate interpretation of the forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), and the FEV1/FVC ratio obtained from spirometry.[6,9] A reduction in FEV1 relative to FVC is a hallmark of asthma and other obstructive lung diseases, resulting in a decreased FEV1/FVC ratio.

Monitoring and performing peak expiratory flow rate are easier; however, the evidence regarding its efficacy remains inconclusive. In this study, we aim to evaluate the comparative efficacy of PEFR and FEV1 in monitoring asthma in children.

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MATERIALS AND METHODS

A descriptive diagnostic test evaluation was conducted in the Department of Pediatrics at Government Medical College, Ernakulam, over a 12-month period, after obtaining the Institutional Ethical Committee Clearance. Based on GINA guidelines, 7-14-year-old children with mild and moderate persistent bronchial asthma who attended Pediatric Outpatient clinic, Government Medical College, Ernakulam were included in the study. Children aged 7-14 years with cardiac disease, congenital chest anomalies, recurrent respiratory infections from other causes, acute severe exacerbations of bronchial asthma, and GERD were excluded from our study.

Data Collection Equipment: A) Peak Expiratory flow meter: It is a compact, portable device designed to assess a person's ability to exhale air. Peak expiratory flow rate (PEFR) measures the maximum expiratory speed, reflecting airflow through the bronchi and the extent of airway obstruction. Bronchial asthma typically results in reduced PEFR values. A variability of more than 20% in the peak expiratory flow meter, along with a 12% increase after bronchodilation is considered diagnostic for bronchial asthma.[9]

B) Spirometry: This is a computer-based test. A spirometer is a compact device that measures the volume of air inhaled and exhaled, as well as the expiratory speed. The personal best value is taken from three measurements. FEV1 and FVC are measured where is FEV1 is Forced expiratory volume in 1 second and FVC is forced vital capacity. Obstructive airway diseases, including asthma, typically show reductions in both FEV1 and the FVC/FEV1 ratio. Obstructive airway diseases, including asthma, typically show reductions in both FEV1 and the FVC/FEV1 ratio [2].

Study Procedure

Study Design: Descriptive, diagnostic test evaluation study

All children in the age group of 7-14 years with mild persistent and moderate persistent asthma who met the inclusion criteria and attended the Pediatric OPD from January 1, 2018, to December 31, 2018, were selected for the study. After taking the consent & doing initial assessment, the child was instructed the correct technique of performing PEFR and spirometry. PEFR was measured during both visits using a peak flow meter. FEV1 was measured in the same manner using computer-based spirometry performed under the supervision of a trained technician. The best of three recorded values was chosen. During the first visit, children who needed inhalers were started on the same and if already using, dose/compliance was reassessed and corrected accordingly.

During their 2nd visit after 4 weeks, values of PEFR and FEV1 were obtained. Those who were in acute phase and who did not come for review were dropped from the study.

Changes in PEFR and FEV1 during both the visits were calculated in percentage and compared. Any change of more than 20% in PEFR and 12% in FEV1was considered significant.[9]

Statistical Analysis: The values were coded and entered into an Excel sheet, and the data was analyzed using SPSS software. Specificity, sensitivity, positive predictive value and negative predictive values were calculated. The mean PEFR and FEV1 were determined, and their correlation was analysed. Mean values of change in PEFR & FEV1 were compared with independent t test. Discordant pairs for significant changes in PEFR and FEV1 were analyzed using the McNemar test. A p-value of less than 0.05 was considered significant.

RESULTS & DISCUSSION

Out of the 199 children included in the study, it was found that boys were more affected (54%). Studies by Raghavan D and Jain R[11] and R Pal, Dahal S and Pal S [12] have identified male sex, atopy, and parental atopy as risk factors for wheezing. In the study published by Becklake MR and Kauffmann F in 1999, it was noted that males had an increased risk of asthma because of increased bronchial lability and dysanapsis.[16,17]

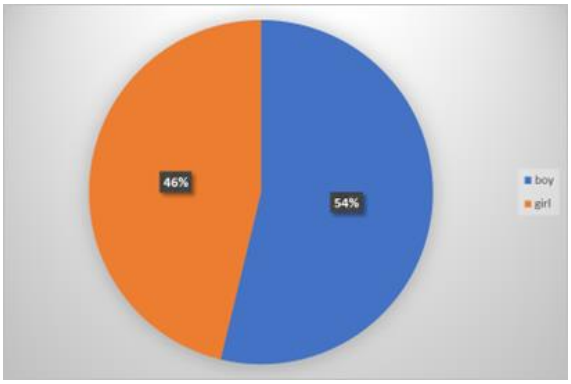

Figure 1: Pie chart showing gender distribution

The mean age of participants in the study was 9 years. 72% children belonged to 10-14 years age group. Pal R, Dahal S and Pal S[12] had made a similar observation in his study where children 6-12-year-old were more affected. A study conducted by Jain A, Vinod Bhat H and Acharya D[10] demonstrated an inverse relationship between asthma and increasing age. The findings may be because younger children are more exposed to various environmental risk factors, such as cooking fuels, and are more vulnerable to viral infections than older children.

Our study showed most of the children were having normal to underweight even though previous studies show that there was increased incidence of asthma in obese children. No positive correlation with obesity was observed in our study.[13]. Obesity is considered a risk factor for asthma, as it can lead to reduced respiratory compliance and changes in airway

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resistance due to increased intra-abdominal pressure, which affects the diaphragm.[18-20]

84% children of the study population had mild persistent asthma and the remaining were found to have moderate persistent asthma. 45% children among the study population were on controller drugs.

Correlation between PEFR & FEV1

PEFR and FEV1 measured during the first visit showed a positive correlation, with a correlation coefficient of 0.75. This is depicted as scatter diagram in Figure 2.

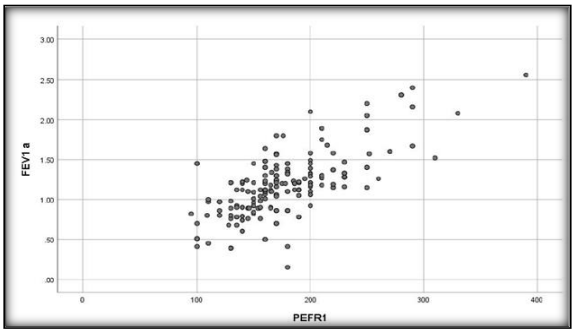

Figure 2: Scatter diagram showing positive correlation between PEFR & FEV1

Mean PEFR at second visit was found to be increased compared to initial value which was statistically significant and had positive correlation. Mean FEV1 during first and second visit also showed positive correlation which was also statistically significant.

Comparison of PEFR values and FEV1 values in two visits is shown in Table 1.

In our study, we found that PEFR has a positive correlation with age. Studies done by Abraham B, Baburaj S, Patil RB, Mohandas MK, Ruhman S and Raj S,[13] and Manjunath CB, Kotinatot SC and Babu M,[14] showed similar results. Changes in PEFR and FEV1 during two visits, 4 weeks apart were compared and it was observed that they were positively correlating, though not statistically significant.

PEFR test results were compared to FEV1, the gold standard and the results are presented in Table 2 and 3 below. Among the 43 children who showed a significant change in PEFR, only 28 also displayed a change in FEV1. Additionally, out of the 106 children who exhibited a positive change in FEV1, 28 did not show a significant change in PEFR. The sensitivity was 26.4%, and the specificity was 83.9%. Table 2 shows comparison of PEFR with FEV1 and the sensitivity, specificity, positive and negative predictive values has been shown in Table 3.

Mcnemar value of 0.01 was obtained which indicates that PEFR could not be used instead of FEV1 in monitoring of asthma.

Among 106 subjects who showed positive change in FEV1, only 29 subjects had a significant change in PEFR. This shows that the sensitivity of PEFR over FEV1 in asthma monitoring is only 26.4% and changes in FEV1 may be missed while using PEFR alone. Similar observations were made by Gharagozlou M, Kompani F and Movahedi M in 2004.[15] The sensitivity of PEFR was low in our study. A similar observation was made by Gautrin D, D'Aquino LC, Gagnon G, Malo JL and Cartier A[4] in 1994 where PEFR had a poor sensitivity compared to FEV1 as there is a chance of overestimation and underestimation.

Table 1: Comparison of PEFR and FEV1 during 2 visits & their correlation.

	Mean	Standard deviation
PEFR 1st visit	178.45	45.99
PEFR 2nd visit	202.8	46.16
P value 0.01 r=0.93		
FEV1 1st visit	1.17	0.39
FEV1 2nd visit	1.32	0.39
P value 0.01 r=0.97		

Table 2: Comparison of PEFR & FEV1 with respect to treatment response

Test	FEV1 positive	FEV1 negative	Total
PEFR positive	28	15	43
PEFR negative	78	78	156
Total	106	93	199

Table 3: Sensitivity, specificity, positive & negative predictive value of PEFR.

	PEFR (in assessing response)
Sensitivity	26.4%
Specificity	83.9%
Positive predictive value	65.1%
Negative predictive value	50%

CONCLUSION

PEFR exhibits a much lower sensitivity in evaluating treatment response to inhaled corticosteroids when compared to FEV1, the gold standard test. Our findings indicate that PEFR may only detect changes in the presence of severe obstruction, potentially missing small changes in the airway, and may either overestimate or underestimate changes in spirometry. Therefore, we conclude that, while PEFR is a more straightforward tool for assessing airway obstruction in routine outpatient settings, especially in a resource

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limited setting, the results should be correlated with or confirmed by spirometry whenever feasible, and any changes in treatment should be based on spirometry findings.

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