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COMPARISON BETWEEN PEFR AND FEV1 IN MONITORING BRONCHODILATOR RESPONSE IN 7-14 YEAR OLD ASTHMATICS ATTENDING GOVERNMENT MEDICAL COLLEGE ERNAKULAM

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ABSTRACT

INTRODUCTION

Bronchial Asthma is a chronic inflammatory disorder of the airways leading to considerable morbidity. Spirometry and peak expiratory flow rate (PEFR) are the tools used to assess asthma
where FEV1 (Forced Expiratory Volume in one second) is considered the gold standard.
PEFR is a simpler tool, but has a chance of underestimation or overestimation. We routinely use PEFR in our setting for assessment of asthma. So it was important to investigate further tosee if changes in PEFR can adequately evaluate changes in airway caliber as estimated byFEV1.Hence with the objective to compare pre and post bronchodilator changes in PEFR and FEV1, we conducted this study in asthmatic children.

METHODOLOGY

A descriptive study –diagnostic test evaluation was conducted on 199 asthmatic
children of the age group 7-14years attending Paediatric outpatient clinic, Government
Medical College Ernakulum over 1 year selected by non random sampling method. Peak expiratory flow rate and forced expiratory volume in one second was measured for each subject before and after a bronchodilator and change in the values were expressed as percentages. Bronchodilator reversibility of more than 12 percent was considered significant for both. Sensitivity, specificity, positive& negative predictive value was calculated for change in PEFR & FEV1 with respect to bronchodilator reversibility.

RESULTS & DISCUSSION

In the present study mean values of PEFR and FEV1 was correlating positively (r-0.9). Percent change in PEFR & FEV1 post bronchodilator was having positive correlation(r-0.25). PEFR showed sensitivity of 72% and specificity of 37.9%. Mcnemar test done showed significant results with a p value of 0.017.

CONCLUSION

Our study showed that PEFR had a low specificity in detecting bronchodilator response compared to FEV1 and hence we would conclude that PEFR results have to be correlated with spirometry results while assessing bronchodilator response.

Key words: Bronchial asthma, PEFR, FEV1, Bronchodilator

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INTRODUCTION

Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation.The disease begins in childhood in 50% of cases.Incidence of asthma in children is on a rising trend in developing countries including India which is around 6% in the age group 6-20years(1).According to the GINA guidelines bronchial asthma can be diagnosed by the following criteria (2)

1. Typical symptoms like cough, breathlessness and wheeze which (a)Exacerbate during early morning or night (b) Exacerbate on exposure with risk factors
2. Evidence of variable expiratory airflow limitation which can be done by doing PEFR.PEFR variability should be more than 13% in bronchial asthma. Reversibility with bronchodilators are also a characteristic feature.

Assessment of pulmonary function should complement symptom evaluation in the diagnosis of obstructive lung diseases, such as asthma.In fact, there is no gold-standard method for making a diagnosis of asthma; the symptoms and variability of airflow limitation are the parameters often evaluated during diagnosis(3)(4)(5). Home monitoring of expiratory flow is a recommended way in monitoring of asthma , but spirometry is considered the gold standard as there is a high chance of missing obstruction with clinical symptoms and peak expiratory flow.(6)(7)(8).Bronchodilator response also needs objective assessment .

Though spirometry is considered gold standard, some studies have shown FEV1 as poor predictor of bronchodilator response. Peak expiratory flow rate is easier to monitor and perform. Regarding the efficacy of PEFR, evidence is still inconclusive . Hence we aim to do this study to compare efficacy of PEFR & FEV1 in monitoring of asthmatic children.

METHODOLOGY

Study Design

Descriptive study- Diagnostic Test Evaluation

Study Subjects

Children 7-14 years of age with Asthma who attend Paediatric Outpatient clinic,Government Medical College, Ernakulam, who are already diagnosed to have mild & moderate persistent bronchial asthma based on GINA guidelines,were included.

Exclusion Criteria

- Children 7-14 years with
- cardiac disease
- congenital chest anomalies
- recurrent respiratory infections due to other causes
- acute severe exacerbation of bronchial asthma
- GERD

199 study subjects satisfying the above criteria were included in the study .Thus the objective of the study was to compare pre and post bronchodilator changes in PEFR and FEV1 in asthmatic subjects 7-14 years age attending Paediatric OP, government medical college, Ernakulam. We hypothesised that large proportion would have significant change in FEV1 compared to PEFR .

Data Collection

Equipments

Peak Expiratory flow meter: it is a small hand held device used to monitor a person's ability to breathe out air. Peak expiratory flow rate is a person's maximum speed of expiration. It measures airflow through the bronchi and thus the degree of obstruction in the airways. PEFR value will be reduced in bronchial asthma. If the peak expiratory flow meter variability will be more than 20% and if there is reversibility of 12% after bronchodilatation, it is diagnostic of bronchial asthma.(9)

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Computer based Spirometry:
Spirometer is a small machine which records the air breathed in and out and the expiratory speed. It takes three values and personal best is taken. Forced expiratory volume in 1 second and forced vital capacity will be obtained. In obstructive airway diseases like asthma, FEV1 and FVC/FEV1 ratio will be reduced.Score of 80% or more of the predicted is considered normal. FEV1 increases by >200mL and >12% of the baseline value (or in children, increases by >12% of the predicted value) after inhaling a bronchodilator. This is called bronchodilator reversibility. (9)(2)

Study Procedure
Consecutive cases of mild persistent and moderate persistent asthma of age group 7-14 years who meet the inclusion criteria attending the Paediatric OPD were selected. After taking the consent and filling the proforma ,initial assessment was done. Child was educated how to perform PEFR and spirometry .Pre and post bronchodilator PEFR for the first visit of the subject obtained using peak flow meter. FEV1 obtained similarly with computer based spirometry performed by a skilled technician. 3 values were taken and the best of the three was recorded.PEFR and FEV1 values pre and post bronchodilator (Salbutamol according to the weight was given) for the visit was also obtained. (Nebulising mask was disinfected after each use appropriately). Changes were calculated as percentages and compared. 12% change was considered significant for both the parameters. Values coded and entered in Excel sheet. Data analysed with SPSS software. Sensitivity, Specificity, Positive predictive value, Negative predictive values obtained. Mean PEFR and mean FEV1 in response to bronchodilator calculatedand correlation between them was assessed. Mean values of change in PEFR & FEV1 werecompared with independant t test for significant change.
Discordant pair for significant change in PEFR & FEV1 was tested using Mcnemar test.P value less than 0.05 was taken as significant.
Funding
Self
Ethical Clearance
The study protocol was submitted to the institutional research committee and clearance was obtained.

RESULTS

This study was conducted in Government Medical College Ernakulam on 199 children in the age group 7-14years who attended Paediatric Outpatient Clinic during the time period first January 2018 to thirty first December 2018.

DEMOGRAPHY
Mean age of the study population was found to be 9.05years with a standard deviation of 2.14. There were 107 boys and 92 girls in the study. Mean weight of the group was 26.6kilogram with standard deviation of 8.08 and mean height was found to be 130.11centimeters with standard deviation of 10.9.
Among our study subjects, 107 were boys and 92 were girls. Among the asthmatic children, 168 were having mild persistent asthma and 31 had moderate persistent asthma.90 of the study subjects were on inhalers whereas 109 were not using them.

Table 1: Baseline Demographic & Clinical Characteristics (n=199)

Age	7-14 years (9.05)
Gender (boys/girls)	107/92
Weight	14-58 kg (26.6)
Height	110-156 cm (130.11)
Asthma type(Mild persistant/moderate persistant	168/31
Subject who were using inhalers/not	90/109

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Comparison between Mean PEFR, FEV1 & demographic variables

When mean PEFR & mean FEV1 were compared with increasing age, weight &height , both were found to be increasing with all the three parameters & the results were statistically significant.

PEFR values showed positive correlation with all the three parameters. Similar results were observed for FEV1.

Table 2: Comparison between mean PEFR,FEV1& demographic variables

	Mean PEFR (p value)	Mean FEV1 (p value)
Age group 7-10 yrs	163.72	1.05
10-14 yrs	217.02 (0.035)	1.5 (0.02)
Height group 110-130 cm	169.9	0.98
	209.2 (0.001)	1.45 (0.01)
Weight group 10-30 kg	163.9	1.05
30-60 kg	225.2 (0.001)	1.59 (0.002)

Correlation between PEFR & FEV1

PEFR and FEV1 during the visit were positively correlating with correlation of 0.75.

Figure depicts scatter diagram showing positive correlation between PEFR & FEV1.

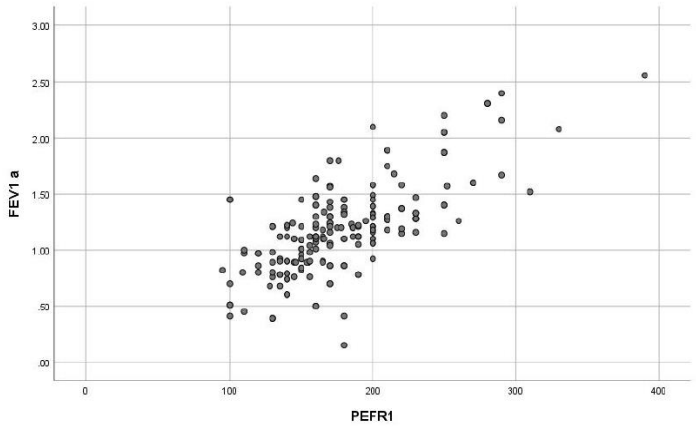

Figure 1 : Scatter diagram showing correlation between PEFR & FEV1

Changes with bronchodilator

Table below shows mean & standard deviation(SD) of PEFR & FEV1 pre and post bronchodilator and their significant relation.

Table 3 : Mean, SD of PEFR & FEV1 pre and post bronchodilator (statistical significance is shown by p value)

	Mean	
PEFR pre bronchodilator	178.35	46.09
PEFR post bronchodilator	208.32	48.73
P value 0.01		
FEV1 post	1.18	0.38
FEV1 post	1.33	0.40
P value 0.01		

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Both PEFR and FEV1 showed positive correlation with use of bronchodilator.Post bronchodilator, both PEFR & FEV1 showed increasing trend mostly. Change in PEFR pre and post bronchodilator use was statistically significant . Similarly change in FEV1 was also significant.
Validity of PEFR in comparison to the gold standard was assessed. The results are shown in the Tables 4 & 5 below. Out of 135 children who had significant change in PEFR, only 81 had change in FEV1. Out of 112 children who had positive change in FEV1, 31 did not show change in PEFR. Hence sensitivity was found to be 72.3% and specificity 37.9%.

Table 4 : Comparison of PEFR & FEV1 with respect to bronchodilatorreversibility

Test	FEV1 positive	FEV1 negative	Total
PEFR positive	81	54	135
PEFR negative	31	33	64
Total	112	87	199

Table 5 : Sensitivity, specificity, positive & negative predictive value of PEFR with repect to bronchodilator reversibility.

Sensitivity	72.3%
Specificity	37.9%
Positive predictive value	60%
Negative predictive value	51%

Mcnemar test done was significant with a p value 0.017 showing that PEFR cannot be used instead of FEV1 in assessing bronchodilator reversibility.

DISCUSSION

A study was conducted in asthmatic children 7-14years in a tertiary care centre to look whether peak expiratory flow meter use for monitoring bronchodilator response in asthma is the same asspirometer.Mean age of our study subjects was found to be 9 years. Most of the children affected were under 10 years. A study by Ranabir Pal et al showed similar observation where children in the age group 6-12years were more affected than above 12 years. Similar observation was made in a study conducted by A Jain et al which showed inverse relation of asthma with increasing age. The findings may be due to the fact that the younger children are more exposed to multiple environmental risk factors including cooking fuels and they are prone for viral infections compared to older ones(10)(11) In our study, boys were found to be more affected. Similar observations were made in the study done by Raghavan et al. and Ranabir et al. These studies have shown that male sex,atopy and parental atopy are risk factors for wheeze. According to studies done on gender difference in asthma, males were prone to have increased risk of asthma because of increased bronchial lability.(11)(12)
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.There was no positive correlation noted in our study with obese children. Obesity is considered a risk for asthma as those children will have reduction of respiratory compliance and changes in airway resistance beacause of increased intraabdominal pressures reflecting on diaphragm.(13)(14)

Studies have shown definite improvement in PEFR and spirometry values after use of inhalers. A study done by Philip O Anum et al in 77 subjects showed that after 1 month of inhalers, there was definite improvement in PEFR(15) Difference in observation in our study may most probably due to poor compliance/ lack of correct technique of the subjects. PEFR values were found to be positively correlating

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with age. Studies done by Manjunath et al in 1028 children and study done by Archana et al shows similar results.There was also positive correlation between height and weight(16)(17).

Similar results were obtained for FEV1 with age, weight and height.Study done by Kirenga et al shows that with short acting beta agonist, there will besignificant reversibility in bronchospasm reflected in PEFR & FEV1. In our study also,

broncho-reversibility was found to be significant(18) Sensitivity in assessment of bronchodilator reversibility was found to be 72.3%. But out of 87 who showed no bronchodilator reversibility in spirometer, 54 showed significant change in PEFR. This may indicate that PEFR has a chance of overestimation. Specificity of PEFR was found to be only 37.9% where out of 87, only 33 were negative results in FEV1 with bronchodilator. The positive and negative predictive values were found to be 60% and 51 % respectively.Similar results were obtained in a study conducted by Gautrin et al. Most of the studies came with an observation that PEFR was less sensitive in monitoring , but certain studies like the study done by Cross et al in 56 subjects showed that PEFR could be used well in monitoring even at home though it could miss a few cases .(19)(20)(3)(4)(8)

CONCLUSION

When compared to the gold standard test FEV1, PEFR has got alow specificity in assessing the bronchodilator reversibility. The findings would suggest that PEFR may detect changes only when there is severe obstruction and may miss small changes in airway and can over or underestimate changes in spirometry. Hence we would conclude that though PEFR is a simpler tool to assess airway obstruction on daily routine outpatient basis, the results should be correlated or verified with spirometry whenever possible. Modifying the treatment or accurate measure of response would need use of spirometry and Peak expiratory flowmeter would not suffice. Limitation of our study was that children may not be accurately using the tools for assessment of asthma because of lack of understanding and inability to use the machine. This may alter our results.

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