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Utility Of Home Peak Flow Monitoring In Bronchial Asthma

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Abstract

Background: Asthma is a chronic inflammatory disorder characterized by airway hyperresponsiveness, leading to recurrent episodes of wheezing, chest tightness, and coughing. Peak Expiratory Flow Rate (PEFR) monitoring is a simple, cost-effective method to assess pulmonary function and potentially improve asthma management. Objective: This study aimed to evaluate the utility of home PEFR monitoring in asthma management compared to standard symptom-based management. Methods: A prospective, interventional, case-control study was conducted with 60 asthma patients (30 cases and 30 controls) from a tertiary care institute. The study group performed daily home PEFR monitoring, while the control group received standard asthma education. Pulmonary function tests, exacerbation rates, hospital admissions, and Asthma Control Test (ACT) scores were recorded and analyzed over one year. Results: The study showed significant reductions in PEFR reversibility (from 8.58% to 3.25%, $p<0.01$), ACT scores (from 20.11 to 21.78, $p<0.01$), exacerbation rates (from 6.09 to 2.36, $p<0.01$), and hospital admissions (from 0.54 to 0.27, $p=0.034$) in the study group compared to the control group. A strong positive correlation was found between pre-bronchodilator FEV1 and PEFR values ($r=0.939$), and a significant negative correlation between ACT scores and exacerbations ($r=-0.831$) and admissions ($r=-0.742$). Conclusion: Home PEFR monitoring, combined with asthma education and a symptom-based action plan, significantly reduces asthma exacerbations and hospital admissions. Regular monitoring and educational interventions are crucial for effective asthma management.

Key words: Asthma, Peak Expiratory Flow Rate, Home Monitoring.

INTRODUCTION;

Asthma is defined as a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. Chronic inflammation is associated with airway hyperresponsiveness that leads to recurrent episodes of wheezing, chest

tightness, and coughing, particularly at night or early morning. These episodes are usually associated with widespread but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment.[1]
Clinical manifestations of asthma can be controlled with appropriate treatment. When asthma is controlled, there should be no more than occasional flare-ups and severe exacerbations should be rare.

Peak expiratory flow is the maximum flow rate attained during the FVC maneuver. It is measured with the help of a peak flow meter. It is an effort-dependent test. It measures large airway function and muscular effort. Decreased values correlate with the worsening of asthma. It is very simple and rapid test that can be measured at the bedside, in the emergency department, in the clinic, or at home with good precision. Its drop may suggest an early exacerbation of asthma even before the marked worsening of symptoms and hence necessary intervention can be donned. hence necessary intervention can be done.[2] It is a relatively inexpensive, portable, plastic and ideal for patients to use in home settings.

Asthma control is important to assess in clinical practice, although it is multidimensional, characterized by symptoms, changes in pulmonary function, and effects on quality of life and functional ability. Measures of pulmonary function, symptoms, and quality of life often correlate poorly with one another and appear to provide independent information about clinical status, with lung function providing a point-in-time assessment and questionnaires assessing status over a given time period. Assessing any one of these aspects alone does not accurately gauge asthma control, but the routine assessment of all of these aspects individually is usually not feasible given constraints on time and resources in the clinical setting. In particular, spirometry is often not available in the primary care setting. Peak expiratory flow rate monitoring is a simple tool that may help in routine day-to-day assessment of asthma.

The present study aims to explore the utility of home PEFR monitoring of patients with asthma in comparison to those patients of asthma not using the same.

MATERIAL AND METHODS;

Study Design and Population

This study is a prospective, interventional, case-control study conducted over one year. The study population comprised 60 patients attending a tertiary care institute's outpatient chest medicine department, diagnosed with bronchial asthma by a chest physician. Asthma was diagnosed based on clinical history and historical evidence of typical asthma physiology, including peak expiratory flow rate variability, FEV1 reversibility of >12%, or bronchial hyperresponsiveness. Patients were randomly divided into study and control groups. Informed written consent was obtained from all patients before their inclusion in the study.

Inclusion Criteria

- Diagnosed cases of bronchial asthma by a chest physician based on clinical history and spirometry.
- Patients aged 18 years and above.

Exclusion Criteria

- Patients with other chronic lung diseases such as chronic obstructive pulmonary disease, bronchiectasis, and tuberculosis.
- History of smoking.
- Patients unwilling to give consent.
- Patients under 12 years of age.
- Patients unable to perform pulmonary function tests (PFT).
- Patients in exacerbation.
- Any active infection.
- History of myocardial infarction in the last month.

Study Procedure

Participants underwent a brief questionnaire and clinical examination followed by measurement of lung functions using spirometry with post-bronchodilator studies. The control group received personalized asthma education regarding symptoms and emergency care. The study group was additionally advised to perform daily home peak expiratory flow rate (PEFR) monitoring. Based on the National Asthma Education and Prevention Program, patients with PEFR less than 80% of their personal best were considered to be in exacerbation, and those with PEFR less than 50% of their personal best were admitted to the hospital.

Data Collection

The questionnaire included questions regarding disease control, associated symptoms, and the personal and treatment history of the patient. The control group also completed a similar questionnaire. Variables measured included FEV1, FVC, FEF25-75%, variability, and reversibility on both FEV1 and PEFR, which were compared with the frequency of hospital admissions and exacerbations.

Statistical Analysis

Data were entered using MS Excel 2007 and analyzed using SPSS version 16 software. Statistical tests applied included the unpaired t-test for comparison of means between two groups for numerical data, the paired t-test for comparison of means between two groups before and after an intervention, and Pearson's correlation for correlation between two numerical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS;

Table; 1 The characteristics of the study subjects are presented in the table below:

Characteristic	**Cases (N=30)**	**Controls (N=30)**
Male/Female	18/12	19/11
Age (years)	34.1 ± 5.4	41.7 ± 6.2
Height (cm)	157.8 ± 7.3	160.2 ± 8.1
Weight (kg)	58.1 ± 9.5	60.7 ± 10.2

Table; 2 Comparison of basic parameters of PFT and PEFR between the study and the control group before the start of the study.

Parameter	**Group**	**N**	**Mean**	**Std. deviation**	**P –value**	**Significance**
Absolute FEV1 (Pre)	Cases Control	30 30	1.84 1.99	0.87 0.91	0.537	Not significant
%Pred FEV1 (Pre)	Cases Control	30 30	73.14 85.97	28.45 31.2	0.101	Not significant
FEV1/FVC	Cases Control	30 30	82.12 70.63	14.45 14.51	0.723	Not significant
Absolute PEF_{25-75}	Cases Control	30 30	1.34 1.58	0.93 1.16	0.388	Not significant
%Pred FEF_{25-75}	Cases Control	30 30	43.74 57.49	29.43 36.39	0.113	Not significant
Reversibility on FEF_{25-75}	Cases Control	30 30	40.23 42.97	42.03 49.06	0.816	Not significant
Absolute PEFR	Cases Control	30 30	5.33 5.81	1.86 2.54	0.408	Not significant
%Pred PEFR	Cases Control	30 30	85.07 95.83	23.94 35.38	0.173	Not significant
Reversibility on PFT(Fev1)	Cases Control	30 30	14.47 16.01	13.43 17.10	0.699	Not significant

(Unpaired t-test) ($P < 0.05$- significant)

Table; 3 Comparison of basic parameters of PFT and PEFR between the study and the control group before the start of the study and at the end of the study period.

Parameter	Group	N	Mean	Std. deviation	P –value	Significance
Reversibility of PEFR on PFT (start)	Cases Control	30 30	11.82 15.08	17.62 17.05	0.452	Not significant
Reversibility on PEFR meter(start)	Cases Control	30 30	8.58 9.44	8 12.44	0.801	Not significant
Reversibility on PEFR meter(end)	Cases Control	30 30	3.25 8.68	3.42 7.13	<0.01	significant
ACT score(start)	Cases Control	30 30	20.11 19.47	2.69 2.73	0.345	Not significant
ACT score(end)	Cases Control	30 30	21.78 20.31	1.45 2.66	<0.01	Significant
Exacerbation rates	Cases Control	30 30	2.36 6.09	1.45 3.06	<0.01	Significant
Admission rates	Cases Control	30 30	0.27 0.54	0.44 0.81	0.034	significant

(unpaired t-test) (P < 0.05- Significant)

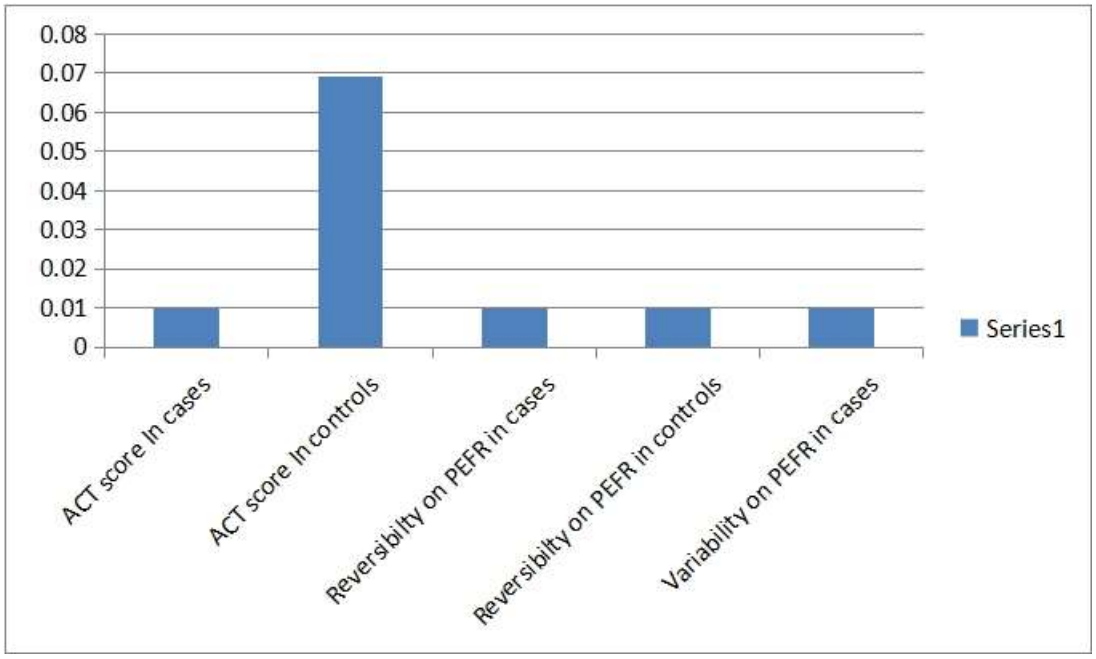

Figure 1: Graphical representation of the level of significance of the variables before and at the end of the study period. P-values <0.05 were considered significant.

Table; 4 Correlation using Pearson's Correlation Coefficient (Cases & Control)

Parameter	Exacerbation		Admission	
	Cases	Control	Cases	Control
FEV1 (%pred)	-0.367	-0.591	-0.290	-0.370
FEV1/FVC	-0.494	-0.485	-0.403	-0.466
FEF_{25-75} (% pred)	-0.388	-0.485	-0.310	-0.588
PEFR (% pred)	-0.420	-0.640	-0.287	-0.606
Reversibility (FEF_{25-75})	0.264	0.388	0.168	0.564
Reversibility (FEV1) on PFT	0.493	0.539	0.363	0.635
Reversibility (PEFR) on PFT	0.467	0.738	0.461	0.854
Reversibility on PEFR at the start	0.629	0.790	0.590	0.815
ACT score at the start	-0.735	-0.831	-0.700	-0.742

DISCUSSION;

Asthma control is important to assess in clinical practice, although it is multidimensional in nature, characterized by symptoms, changes in pulmonary function, and effects on quality of life and functional ability. Measures of pulmonary function, symptoms, and quality of life often correlate poorly with one another and appear to provide independent information about clinical status, with lung function providing a point-in-time assessment and questionnaires assessing status over a given time period. Assessing any one of these aspects alone does not accurately gauge asthma control, but routine assessment of all of these aspects individually is usually not feasible given constraints on time and resources in the clinical setting. In particular, spirometry is often not available in the primary care setting. Peak expiratory flow rate is a simple tool which may help in routine day to day assessment of asthma.

The study consisted of 60 patients (30 cases and 30 controls) with mean ages of 34.1 and 41.7 years, mean height of 157.8 and 160.2cm, and mean weight of 58.1 and 60.7kgs in cases and controls respectively. There was no correlation observed between the frequency of exacerbations or hospital admissions and sex, age, height, or weight. The effects of these parameters have been studied in a few studies in the past. In one of the studies from China, the height and weight of children with severe asthma were lower than those of normal children with moderate asthma.[3]

Regarding BMI, the data was correlated with BMI in a few studies. In one study overweight and obese males and females had an increased risk of adult asthma.[4] This finding was consistent across different strata of smoking, education, and physical activity. In a few of the studies, Obesity was associated increase in the incidence of asthma in women but not in men.[5, 6]

There are conflicting data regarding the efficacy of peak flow rate monitoring for improving asthma outcomes. Most studies have shown a benefit when peak flow rate monitoring is linked to a comprehensive program, combined with symptom diaries and patient education.

Aarne et al.[7] compared guided self-asthma using peak flow with symptom-based management and found it to have an incidence of asthma exacerbation of 0.6 per year in the guided asthma plan compared to 2.1 per year in the other group.
In our study we found a strong correlation between the prebronchodilator absolute FEV1 and PEFR values. (r=0.939)
The value of PEFR is given by the formula:
PEFR = FEV1 x 1.9996 + 1.6334

In one study it was found that correlation was 0.83 when the same two values were compared.[8] Hence the study shows that PEFR is a useful parameter which correlates strongly with FEV1 and hence can be used for monitoring of asthma, especially in places where spirometry is lacking.

The present study showed strong correlation (r= 0.747) between reversibility showed by spirometry and FEV1.
The correlation is given by the formula :

Reversibility in PEFR %= 0.4455 (reversibility in FEV1) + 2.1575
Gautrin et al[8], found a correlation of 0.65 between the two.
Hence the study shows that PEFR is a useful parameter that correlates strongly with FEV1 and hence can be used for monitoring asthma.
The average PEFR reversibility also dropped significantly from 8% to 3.42% in the one year in the study group as compared to drop from 9.4 to 7.1 in the control group.
The study showed that as the ACT score of the patient decreases, the frequency of exacerbations increases. (r= -0.831). Wei et al[9], showed the correlation between the ACT score and the future risk of exacerbation by depicting a graph of Odd's ratio.
There is an evident association between current asthma control level and future risk of asthma exacerbation. Patients without well-controlled asthma have high odds of asthma exacerbation compared to those with controlled asthma.

CONCLUSIONS;

This study found no correlation between gender, height, weight, or age and asthma exacerbation frequency. However, using a peak flow meter combined with asthma education and a symptom-based action plan significantly reduced asthma exacerbations and hospital admissions.

Pre-bronchodilator FEV1 and PEFR were positively correlated, as were their reversibility measures. PEFR reversibility was positively correlated with the number of exacerbations and admissions, while % predicted FEV1 was negatively correlated with these outcomes. The ACT score had the strongest negative correlation with exacerbations (r = -0.831) and admissions (r = -0.742). Reversibility in small airway functions is also positively correlated with exacerbations and admissions.

These findings highlight the effectiveness of regular monitoring and educational interventions in asthma management.

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