ORIGINAL ARTICLE

Diurnal Variation in Peak Expiratory Flow Rates of Healthy Young Adults

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ABSTRCT

Diurnal variability in peak expiratory flow (PEF) was studied in 34 healthy, non-smoking adult males in the age group between 18-26 years. The PEFR (L/min.) was measured with mini Wright's peak flow meter for five times in a day, on waking, 9-11,14-16,18-20 hours and at bedtime. The diurnal variability was observed as lowest PEF values at waking in morning, a progressive rise with peak at 18 hours in evening and a small decrease at bedtime. Diurnal variation for individual subject was calculated by using amplitude percent mean (A%M) and was 4.11+/-1.21. We conclude that a definite pattern of diurnal variation in PEF is seen in healthy population and its knowledge is important meaningful interpretation of PEF recordings in disease condition.

Key words: Peak expiratory flow, diurnal variation

INTRODUCTION

Peak expiratory flow rate (PEF) reflects the state of proximal airway calibre and is an effective measure of effort dependent airflow. PEF is a widely adopted measurement to assess and monitor airway obstruction.[1] It is relatively a simple and easy procedure to evaluate respiratory function when compared with pulmonary function testing. PEF monitoring is also a significant clinical tool to assess the degree of 24-h variation (circadian) in lung function because this correlates with bronchial hyper-reactivity.[2] The use of diurnal variation of PEF to assess intermittent airway obstruction is popular in the monitoring of asthma patients.[3] Variability in the airway function during 24 hours, observed as a characteristic diurnal variations in PEF has been observed not only in asthmatics but in majority of healthy persons also.[4]

The present study was undertaken to see the pattern of diurnal variation in peak expiratory flow rate in healthy adult males.

SUBJECTS AND METHODS

The study group comprised of 34 healthy adult males in the age group between 18-26 years. A detailed history was taken and clinical examination of the subjects was performed to rule out any obvious cardio-pulmonary compromise. Subjects with history of smoking, history of respiratory infection during past two weeks or with personal/family history of asthma were excluded from the study. The data sheets were filled for height and weight and PEFR readings. The PEFR (L/min.) was measured with Mini Wright's peak flow meter (Airmed UK) and subjects were individually trained for measuring their own PEFR in L/min by instructing to "inhale fully" and "exhale as hard and as fast as you can" in the first attempt.[5] Subjects were instructed to record PEF five times a day: on waking, between 9 and 11 A.M., between 2 and 4 P.M., between 6 and 8 P.M., and at bedtime and for three recordings at each time. All measurements were made in standing position The best of three PEFR readings in a given time was taken for the analysis.

Statistical analysis: The data was analyzed by normalizing PEF measurements to percentage deviation from observed mean because of large inter-individual differences in mean values of PEFR. Diurnal variation for individual subject was calculated by using amplitude percent mean (A%M) i.e., difference between highest and lowest daily PEF reading as a percentage of the daily mean and standard deviation percent mean.[6] The PEFR values at different time points were analyzed by using one way analysis of variance (ANOVA).

RESULTS

PEFR values of 34 male subjects were measured at waking, 9:00, 14:00, 18:00 hours, and at bedtime. Anthropometric data of study population is given in table 1.

Table 1: Anthropometric data

Age	20.24±2.05 years
Height	170.12±7.10 cm
Weight	59.82±10.66 kg
Body surface area	1.68±0.17 m^2

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The mean PEFR values were lowest in the morning and showed an increase through out the day with peak in evening at 18:00 hours (Table 2.)

Circadian rhythm of PEFR is shown in fig 1. PEFR values are represented as mean ± S.D. of normalized PEFR values, taking 24 hour individual mean PEFR as 100%. Distribution of amplitude as a percent of mean PEF is shown in fig 2

Table 2: PEFR values at different time intervals.

Time (hrs)	Mean PEFR(l/min)	±SD
Walking	507.35	46.47
9-11	518.82	46.46
14-16	523.82	46.04
18-20	526.76	46.37
Bed time	513.23	45.77

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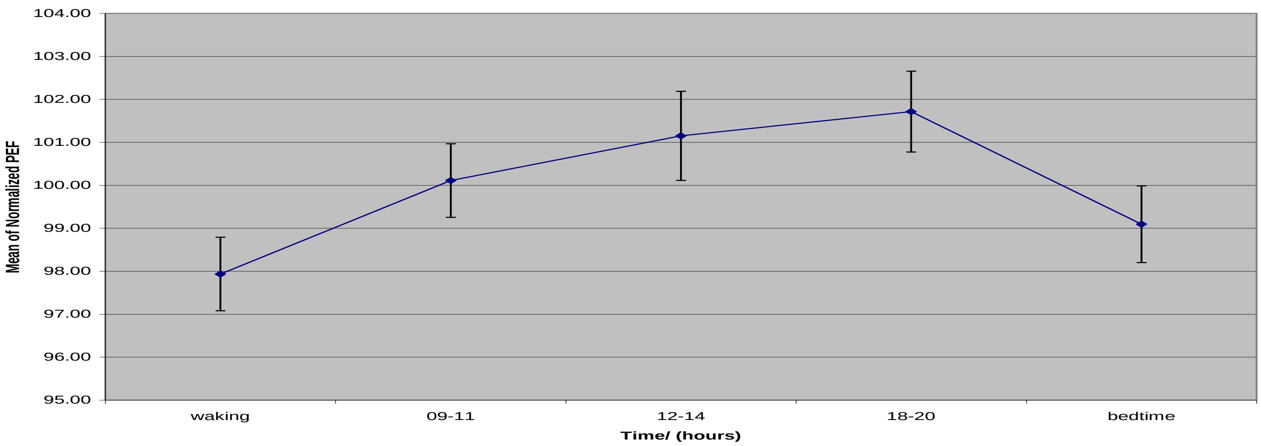

Fig 1: Circadian pettern of peak expiratory flow rates

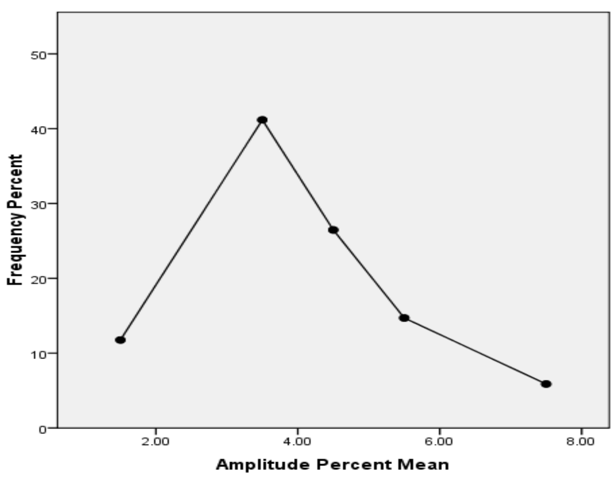

Fig.2 : Distribution of amplitude as a percent of mean PEF

The mean PEF values at different time points points were analyzed for variation using one way analysis of variance (ANOVA) which did not reveal significant rhythm (P>0.4). After normalizing the data, the circadian rhythm became statistically significant (P<0.001).

DISCUSSION

Airway calibre exhibits a circadian rhythm like many human biological systems. In this study a circadian variation in airway calibre of healthy male individuals is observed. Our results show that PEF in normal subjects exhibits definite circadian rhythm characterized by lowest values in the morning followed by progressive rise peaking in the evening and small fall at bed time. 55% of the subjects exhibited an evening peak. Our results are in accordance with other studies[7,8] who have reported a nadir at waking in the morning, a progressive rise upto late afternoon and a plateau or a small decrease at bedtime. The characteristic pattern of diurnal changes in airway tone of asthmatic patients is also of a low PEF early in the morning and an increase during the day.[9] Diurnal variation in peak expiratory flow has been suggested an important measurement in screening and diagnosis of asthma, as well as for assessing disease severity and prognosis[10].

As suggested by Higgins and colleagues[6], amplitude as a percent of the mean PEF was used as a measure of variability in PEF. Our PEF variability results show amplitude percent mean of 4.11% which is almost similar to that reported in literature[11,12,13]. PEF variability can be assessed both as the variation in PEF within a day, and the variation in PEF over several days[14]. Our study population was non-smoker but long-term periodic exposure to air pollution can lead to increased PEF variability even in healthy subjects.[15] Peak expiratory flow variability can be considered as one of the marker of airway lability as are airway hyperresponsiveness to nonspecific bronchial challenger and bronchodilator reversibility[16]. Bronchial responsiveness to non-specific challenges also show a circadian rhythm. In normal subjects the circadian amplitude of airway responsiveness is small , and an increase in amplitude may possibly be one of the earliest signs of bronchial asthma.[17,18] PEF variability study can be considered as an alternate to bronchial challenge testing[12]. There are several advantages of measuring PEF variability over challenge testing. PEF variability is easily and safely assessed, with simple and cheap equipment.

We measured PEF for five times during waking hours which is appropriate to exhibit diurnal. Lebowitz and coworkers[3] have shown that in normal subjects, variability in PEF increases with an increasing number of PEF readings used to derive PEF diurnal variability. Ideally, PEF measurements should be taken frequently during the 24-h period to reflect the true variability.[19] Measurements are generally taken twice daily, usually upon arising and in the evening before bedtime. At least 2-4 daily measurements should be made to obtain a reliable picture of the pattern of variation. It has been suggested that at least four readings per day should be performed, evenly spaced during waking hours, to obtain an accurate assessment of diurnal variation in PEF[20].

CONCLUSION

We conclude that a diurnal variation pattern of PEF is seen in healthy population its knowledge is important for any meaningful interpretation of PEF recordings used to screen population for asthma.

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