Variation in peak expiratory flow in children with asthma

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SUMMARY. Twice daily peak expiratory flow measurements were obtained at home from 65 asthmatic children and 34 non-asthmatic controls, and a measure of the daily variation in peak expiratory flow was calculated for each child (mean daily variation). Children aged less than 7.5 years appeared unable to provide reproducible peak expiratory flows, but above that age the mean of the daily variations was significantly higher for the asthmatics than the controls. This was true even on days when the asthmatics exhibited no wheeze or took no medication. The significance of the findings is discussed, and it is suggested that calculation of the mean daily variation might assist in the assessment of children presenting with atypical respiratory symptoms.

Introduction

EXCESSIVE variation in airway calibre is a fundamental feature of asthma. This is reflected in serial measurements of peak expiratory flow which may be plotted graphically against time. Observers may not agree, however, on the interpretation of such plots and the alternative technique of cosinor analysis has been developed to aid the diagnosis of asthma. This analysis uses computerized multiple regression to fit a sinusoidal waveform to peak expiratory flow records obtained four times a day for seven days. The waveform over an 'average' 24-hour period is displayed, and a peak-to-trough amplitude of greater than 20% of the mean peak expiratory flow has been proposed as a useful test for asthma. Apart from the inconvenience of using a computer-based analysis to diagnose asthma, it may not be appropriate to extrapolate these results which were derived from adults, to children. For example, Johnston and others applied cosinor analysis to results from 64 nine-year-old asthmatics and found a mean wave amplitude of only 12.0%. We therefore analysed our own data with a view to obtaining simpler criteria for the diagnosis of asthma in children based on serial measurements of peak expiratory flow at home.

Method

The case notes were examined of all children aged five to 15 years in a single group practice. Thirty-eight children were diagnosed as asthmatic based on records of at least two episodes of wheeze or of cough treated with a bronchodilator, at least one episode being in the previous two years. On subsequent follow-up all these children exhibited further episodes of wheeze which responded to bronchodilator therapy. Thirty-eight age- and sex-matched controls were also identified, who had no record of wheeze or of treatment for asthma, and whose parents subsequently answered in the negative to the question 'Has your child ever had attacks of wheezing?' Finally, a further 38 asthmatics were identified according to the above criteria in a second group practice, in the same health centre, sex-matched to the first group, and with the same numbers aged five to nine years (18 children) and 10 to 15 years (20 children). For the purpose of this study, the two groups of asthmatics were considered together.

Each child was instructed in the use of a mini-Wright peak flow meter, standard or low range as appropriate. The mother was asked to record the highest of three measurements of peak expiratory flow before breakfast and at bedtime for at least the next seven days, and to record the presence of wheeze and use of medication on each day using a patient record card.

Daily variation in peak expiratory flow was calculated as

\[
\text{higher record} - \text{lower record} \times 100\%.
\]

The mean daily variation was the mean for each individual.

Results

Sixty-five record cards were obtained from the asthmatic children and 34 from the controls. Figure 1 illustrates the mean daily variation plotted against age for the controls, and it can be seen that for children over 7.5 years, the variation was below 7.6%.

There were records from 42 asthmatics and 23 controls aged over 7.5 years. Figure 2 illustrates the distributions of mean daily variation in these older asthmatics and controls. All four distributions were symmetrical (sign test for symmetry of sample distribution, \(P>0.05\) for each) and were therefore subject to parametric analysis. The distribution of mean daily variation among the asthmatics differed little whether all days were included in the analysis (mean 7.1% ± standard deviation 3.4%), only days when no wheeze was recorded (mean 6.4 ± 2.9%) or only days when no medication was used (mean 6.6 ± 2.7%). However, the mean of the mean daily variations for controls (mean 4.4 ± 2.0%) was significantly different from that of the asthmatics for all days (t-test modified for unequal sample variances, \(t=4.01, 63\ df, P<0.001\)).

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Discussion

This study confirms that asthmatic children resemble adult asthmatics in exhibiting greater daily variation in peak expiratory flow than do non-asthmatic controls. Furthermore, the high variation among asthmatics was observed on days when no wheeze was reported and no medication taken. This supports the concept that exaggeration of the rhythm in airflow calibre is fundamental to the pathophysiology of asthma.

The greater range in mean daily variation among control children aged five to 7.5 years than among the older controls is interesting. It seems unlikely that this reflects higher variation in peak expiratory flow in the younger children, and is probably a consequence of variable effort at producing forced exhalations. Clearly these findings should be born in mind in future studies of peak expiratory flow recordings obtained at home in this age group.

Although our sample of non-asthmatic children aged 7.5 to 15 years was fairly small, visual inspection suggests that their mean daily variation values were drawn from a normal parent distribution. Formal testing did not reject this hypothesis (Kolmogorov test statistic = 0.088, \( P > 0.10 \)). Accepting this assumption, it can be shown from these results that mean daily variation would be expected to be below 7.7% in 95% of non-asthmatics. None of our non-asthmatic values was above this limit, but 18 (43%) of the asthmatics exceeded it. We suggest that this observation could be used in the assessment of children presenting with atypical symptoms such as prolonged post-infective cough, episodes of nocturnal coughing or poor exercise tolerance. Although many such children will respond to anti-asthma medication, a therapeutic trial may be inconclusive, particularly if the symptoms are intermittent or subject to large parental variability in recording. The finding in such a child aged 7.5 to 15 years of a mean daily variation in peak expiratory flow greater than 7.7% may provide useful early confirmation of the diagnosis of asthma.

References


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