Relation between FEV₁ and peak expiratory flow in patients with chronic airflow obstruction

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In the assessment and management of patients with airflow obstruction measurements are often available of both forced expiratory volume in one second (FEV_1) and peak expiratory flow (PEF), and it may be desirable to know the relation between the two. During a trial of corticosteroids, for example, it is conventional to monitor PEF twice or four times daily, whereas FEV_1 measurement, if available, is usually performed only once a day or at clinic visits. It is not clear whether the apparently greater sensitivity of peak flow monitoring in these circumstances[1] simply reflects a larger number of measurements made several times a day, or whether measurements of PEF are truly more sensitive than FEV_1 in assessing the response to corticosteroids. Cross sectional studies of patients with airflow obstruction of varying severity have shown a relation between PEF and FEV_1.[2 4] In these reports both indices were expressed in absolute units (litres/minute and litres respectively). Because of the inevitable differences in the age and size of the subjects this may result in spurious correlation, and it is not clear how closely the two indices are related when the effects of these variables are minimised.

We have re-examined the relation between FEV_1 and PEF in a cross sectional study of 61 patients undergoing routine lung function testing and we have assessed the effect on the relation of expressing each index as a percentage of the predicted value. This should minimise variability between subjects, other than that due to the severity of airflow obstruction. We have also studied a group of patients undergoing corticosteroid trials in whom sequential values of both FEV_1 and PEF were obtained at the same time, and from these we have selected those who showed a definite steroid response, to examine within subject relationships between PEF and FEV_1 and to compare these with the relationships in the cross sectional study.

Methods

CROSS SECTIONAL STUDY
Measurements of FEV_1 and PEF were obtained from 61 individuals attending for routine lung function tests. The best of three attempts at each measurement was recorded. Each value was expressed as a percentage of the value predicted from age, sex, and height.[5] The FEV_1 values in these subjects ranged from 0·5 to 5·6 l (10–136% predicted), and PEF values from 80 l/min to 920 l/min (19–151% predicted). In
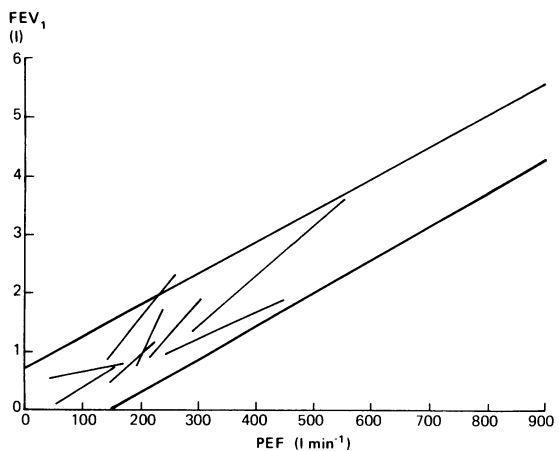
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accordance with the convention of earlier authors,[2 3] we examined the regression of FEV_1 (*y*) on PEF (*x*). The relation was examined firstly in absolute units and then with each value as a percentage of the predicted value. The correlation coefficient, slope of the regression, and 95% confidence limits were calculated.

WITHIN SUBJECT STUDY
The results from eight patients studied during steroid trials were selected on the basis of a sustained rise in FEV_1 of more than 20% (mean rise 78%, range 29–167%). In each subject measurements of FEV_1 and PEF were made at the same time on successive days and the best of three attempts at each was recorded. This gave a mean of eight (range 6–11) readings per subject for each index. Values of FEV_1 were plotted against the corresponding PEF value for each individual, both in absolute units and as percentages of predicted values.

Results

The linear relationship between absolute values of FEV_1 and PEF in 61 patients in the cross sectional study was $FEV_1 = 0.00589\,PEF - 0.0648$; $r = 0.95$, $p < 0.001$. When each index was expressed as a percentage of the predicted value the equation was $FEV_1 = 0.77\,PEF + 5.06$; $r = 0.91$, $p < 0.001$.

Relation between FEV₁ and peak expiratory flow (PEF) (absolute units) for each individual in the "within subject" study plotted with the 95% confidence limits from the cross sectional study.

When polynomial functions were fitted to the data there was no significant improvement in correlations.

In each of the eight patients studied sequentially significant relationships between FEV_1 and PEF were found, the individual correlation coefficients ranging from 0·68 to 0·98. The median value of the slope for this relationship was 5·00 × 10^{-3} (range 2·00–7·50 × 10^{-3}). In the figure the individual relationships are plotted on a graph showing the 95% confidence limits from the cross sectional study. Only one of the 64 points obtained from these patients falls outside the 95% limits from the cross sectional study.

Discussion

The relation between FEV_1 and PEF was very similar to those reported by previous authors,[2][3] with a slope of 5·89 × 10^{-3} compared with 5·67 × 10^{-3} and 5·60 × 10^{-3} in the earlier studies. When FEV_1 and PEF were expressed in relation to predicted values a strong correlation was still found, indicating that the relationship is determined only to a small extent by the size and age of the subjects. The relationships found within individual subjects were on average similar to those seen in the cross sectional study, although the range of slopes for these relationships was rather variable. Although a change in one index of expiratory flow may sometimes exceed the other during steroid trials, the apparently greater sensitivity of PEF monitoring in such patients probably reflects the frequency and timing of the measurements rather than any true difference in sensitivity between PEF and FEV_1.

References

1 Mitchell DM, Gildeh P, Dimond AH, Collins JV. Value of serial peak expiratory flow measurements in assessing treatment response in chronic airflow limitation. *Thorax* 1986;**41**:606–10.
2 Lal S, Ferguson AD, Campbell EJM. Forced expiratory time: a simple test for airways obstruction. *Br Med J* 1964;i:815–7.
3 Ritchie B. The application of simple methods in the functional assessment of obstructive lung disease and respiratory failure. *Med J Aust* 1963;i:259–62.
4 Fairbairn AS, Fletcher CM, Tinker CM, Wood CH. A comparison of spirometric and peak expiratory flow measurements in men with and without chronic bronchitis. *Thorax* 1962;**17**:168–74.
5 Quanjer P (Ed). Standardized lung function testing. *Clin Respir Physiol* 1983;**19**(suppl 5):49.
6 Armitage P. *Statistical methods in medical research*. Oxford: Blackwell Scientific Publications, 1971:163–5.