Peak inspiratory flow through Turbuhaler® in chronic obstructive airways disease

M. H. DEWAR*, A. JAMIESON†, A. MCLEAN‡ AND G. K. CROMPTON

*Respiratory Medicine Unit, Western General Hospital, Edinburgh, U.K.
†Astra Clinical Research Unit, 10 Logie Green Road, Edinburgh, U.K.

Many patients with chronic obstructive airways disease (COAD) receive therapy by the inhaled route. This study was performed to assess whether patients with severe COAD could generate sufficient peak inspiratory flow (PIF) through Turbuhaler® (Astra, Sodertalje) to operate it effectively.

One hundred patients (45 men, 55 women, mean age 69.1 years) with COAD (mean (SD) duration 17.7 (16.3) years) and peak expiratory flow (PEF) < 200 l min⁻¹ or forced expiratory volume in 1 sec (FEV₁) < 1 litre were studied. A series of randomly assigned inspiratory and expiratory lung function tests were contiguously performed, using portable spirometers, within 48 h of a screening visit. An empty Turbuhaler® was used in the study. The patients' normal medication was not restricted. Sixty-six patients were previous smokers, eight occasional smokers, 19 habitual smokers and seven had never smoked.

Mean (SD) FEV₁ was 0.7 (0.2) l and mean PEF was 182 (68) l min⁻¹. All patients were able to generate PIF through Turbuhaler® (PIF-T) of 28 l min⁻¹ (mean 53; range 28-78 l min⁻¹). Eighty-three patients generated PIF-T of ≥ 401 l min⁻¹. PIF-T correlated with PIF without Turbuhaler® (r=0.35), PEF (r=0.3), FEV₁ (r=0.2) and forced vital capacity (FVC) (r=0.23) although the relationships were too weak to be used to predict PIF-T.

The results suggest that patients with severely limited lung function caused by COAD can operate Turbuhaler® effectively.

Introduction

Bronchodilator therapy by the inhaled route is now established as preferable to oral therapy in both chronic obstructive airways disease (COAD) and asthma. Also, anticholinergic bronchodilators are available only for inhalation and are often used in the treatment of COAD as well as inhaled β₂-adrenerceptor agonists such as salbutamol and terbutaline. Many patients with COAD are elderly and are often unable to achieve coordination of inspiration and actuation when using a conventional pressurized metered dose inhaler (1). Turbuhaler® (Astra, Sodertalje) is an inspiratory flow driven dry powder device which can be used in preference to the pMDI (2-4) and does not contain lubricants or propellants, which in themselves can cause bronchoconstriction (5-7). An inspiratory flow rate of ≥ 28 l min⁻¹ through the Turbuhaler® should be generated to operate it effectively (8). This can be achieved by all asthmatic adults (9), children aged 6 years or more (8) and 98% of asthmatic patients with a severe exacerbation requiring hospitalization (10).

This study was designed to assess whether patients with COAD can generate sufficient inspiratory flow to use Turbuhaler® effectively. A second aim was to assess if other lung function variables could be used to predict peak inspiratory flow through Turbuhaler® (PIF-T).

Methods

The study was approved by the local ethics committee and conducted in accordance with the guidelines of the declaration of Helsinki. All patients gave written informed consent.

One hundred and ten patients, aged ≥ 18 years, with a confirmed diagnosis of COAD were screened either in hospital or in the outpatient clinic. One hundred patients (45 men, 55 women, mean age 69.1 years) fulfilled the selection criteria [peak expiratory flow (PEF) ≤ 200 l min⁻¹ or forced expiratory volume in 1 sec (FEV₁) ≤ 1 litre]. Thirty-seven were inpatients following an acute exacerbation of COAD. Sixty-six were previous smokers, eight occasional smokers, 19 habitual smokers and seven had never smoked. Mean (SD) duration of COAD was 17.7 (16.3) years.

Within 48 h of screening, the patients underwent a series of inspiratory and expiratory lung function measurements. The order of these tests (inspiratory vs. expiratory) was...
randomly assigned with a pause of 10 min between assessments. The tests were performed either in hospital or in the patient’s home under the supervision of one of the authors (M.H.D.) using portable spirometers (Vitalograph Compact, Vitalograph Ltd., Buckingham, U.K.). A maximal forced expiration was performed, from which the FEV₁, forced vital capacity (FVC) and forced expiratory flow between 25% and 75% of FVC (FEF₂₅₋₇₅) were derived. PEF was measured using a Vitalograph peak expiratory flow meter with absolute scale. A maximal forced expiration immediately followed by a maximal forced inspiration was performed to measure the peak inspiratory flow without Turbuhaler® (PIF) from the inspiratory limb of the flow volume loop. Peak inspiratory flow through empty Turbuhaler® (PIF-T) was then measured during a maximal forced inspiration using another spirometer attached to an adaptor in which an empty Turbuhaler® was mounted. Noseclips were used for both inspiratory measurements and for all variables the best of three measurements was used for analysis. Relationships between variables were analysed statistically using Pearson product moment correlation tests.

Results

Mean (sd) expiratory flow values were: FEV₁, 0.70 (0.21) l; FVC 1.74 (0.56) l; PEF 182 (68) l min⁻¹. Mean (sd) PIF was 107 (52) l min⁻¹ and PIF-T was 53 (12) l min⁻¹. All patients were able to generate a PIF of at least 28 l min⁻¹ through the Turbuhaler®, 83 generated PIF-T of ≥40 l min⁻¹ and 52 generated PIF-T of ≥60 l min⁻¹. The distribution of PIF-T is shown in Fig. 1. Weak but significant (P<0.05) correlations were found between PIF and FEV₁ (r=0.33), PIF and FVC (r=0.34), PIF-T and PEF (r=0.30) and PIF-T and PIF (r=0.35). No correlation was found between FEF₂₅₋₇₅ and PIF or PIF-T.

Discussion

Turbuhaler® is a high-resistance inspiratory flow driven device. As such, there may have been concern that COAD patients with diminished lung function may have been unable to operate Turbuhaler® effectively. This study was carried out to address this concern.

From the results it is apparent that patients with COAD selected for the study were all able to generate a PIF-T of greater than 28 l min⁻¹. This is sufficient to operate Turbuhaler® effectively and receive a therapeutically active amount of bronchodilator drug to the airways. Significant correlations were found between inspiratory and expiratory flow rates, but these were too weak to allow PIF or PIF-T to be predicted from either PEF or FEV₁. The correlation coefficients found for PIF and expiratory flow rates were lower than those obtained by Brown et al. (10) in 99 adults presenting to hospital with acute exacerbations of asthma and by Engel et al. in outpatients with asthma (11). The latter study examined 101 adults with less severe airways obstruction (mean FEV₁=2.4 l) and similarly found a weak relationship between expiratory flow rates and PIF. This study also found that FEV₁ was less well correlated with PIF-T than with PIF. In contrast to Engel’s study, we found that there was slightly more correlation between PEF and PIF-T than with PIF. However, the overall findings are the same and confirm that both expiratory lung function measurements and standardly measured PIF cannot predict PIF-T through Turbuhaler®.

In summary, this study demonstrates that patients with COAD with low expiratory flow can use Turbuhaler® effectively. These findings are in line with those for patients with acute and moderate to severe asthma.

References

9. Van der Mark TB, Meijer R, Postma DS, Koeter GH. Reliable peak inspiratory flow through
