Home assessment of peak inspiratory flow through the Turbhaler in asthmatic patients

R J Meijer, Th W van der Mark, B J Aalders, D S Postma, G H Koeter

Abstract

Background – The efficacy of dry powder inhalers depends on the patient’s inspiratory flow. Drug delivery from the Turbhaler (Turbhaler in some countries), a multidose powder inhaler, is optimal at flows of >40 l/min. The aim of this study was to investigate the peak inspiratory flow that can be generated by asthmatic patients through the budesonide Turbhaler (PIF_THBH) during maintenance treatment at home.

Methods – Thirty asthmatic patients, consecutively recruited from the outpatient clinic, inhaled their maintenance dose of 800 (n = 16) or 1600 µg/day (n = 14) for two months or one month, respectively. The Turbhaler was connected to a modified V-bitograph Compact installed at home to obtain printed PIF_THBH values for all inhalations. Peak expiratory flow (PEF) was measured twice daily.

Results – Flows were remarkably constant with individual mean PIF_THBH values ranging from 55 l/min to 95 l/min. Only 13 of the 5248 PIF_THBH recordings taken at home (three patients) were <40 l/min and all were >30 l/min. Weekly mean morning PEF values ranged from 114 l/min to 733 l/min. PIF_THBH values could not be accurately predicted from lung function parameters in individual patients.

Conclusions – In a group of stable asthmatic patients inspiratory flow rates rarely fell below the 40 l/min needed to operate a Turbhaler.

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Key words: asthma, peak inspiratory flow, Turbhaler.

Inhalation of aerosolised drugs is widely used in the treatment of asthma. The inhaler systems can be divided into three groups: (1) pressurised metered dose inhalers, (2) dry powder inhalers, and (3) nebulisers. The Turbhaler (Turbhaler in some countries), a multidose dry powder inhaler, is a device from the second group. The clinical effect and deposition of budesonide is higher when using a Turbhaler than when using a pressurised metered dose inhaler.14 However, a sufficient peak inspiratory flow through the inhaler (PIF_THBH) is required to achieve a large percentage of small respirable particles of the drug and an optimal lung deposition.14 Due to the built-in resistance of the Turbhaler this could be a problem in asthmatic patients. Several studies have shown that a flow ranging from 28 to 36 l/min is sufficient to give good lung deposition and clinical efficacy.14 These studies, however, were all performed under supervision of a physician or technician. We have therefore investigated whether a sufficient PIF_THBH is generated when patients use a Turbhaler unsupervised at home.

Methods

Thirty patients with asthma according to ATS criteria9 who attended our outpatient clinic were consecutively recruited into the study. The clinical characteristics of the patients are given in the table. All patients had used a budesonide Turbhaler for at least two months before the study and continued their maintenance dose of budesonide during the study. The study was approved by the local ethics committee of our hospital and all patients gave written informed consent.

CLINICAL ASSESSMENTS

Spirometric measurements were made at the first visit. The patients received a patient diary, a mini-Wright peak flow meter (Clement Clarke Int Ltd, UK), and study medication, and were supplied with two new inhalers instead of their own Turbhaler. One was to be used in series with a calibrated pneumotachograph (V-bitograph Ltd, Buckingham, UK) connected to an adaptor containing a Turbhaler, the other in case access to the first one was not possible. Patients were instructed to inhale deeply and forcefully through the Turbhaler connected to the adaptor and
instructions were given to use the Vitalograph. During the study (at home) the PIF_{THI} value for each inhalation was printed out by the Vitalograph. Patients also measured their peak expiratory flow (PEF) twice daily. Patients were visited at home by the investigator after two days and again after two weeks. After 180–190 doses had been taken from their Vitalograph-connected Turbuhaler the patients visited the outpatient clinic and spirometric measurements were repeated and diary cards and study medication were collected.

DATA ANALYSIS

Correlations between lung function parameters were investigated by Pearson’s product moment correlation after checking for normal distribution. The level of significance was p<0.05.

Results

Twenty nine of the 30 patients completed the study; one could not complete the study due to an asthma exacerbation. The study lasted 23–60 days depending on dose (1600 or 800 μg/day) used in the individual patient; 147–224 inhalations per patient were measured.

Patients inhaled through the Turbuhaler with an average flow of 68 l/min. The distribution of all PIF_{THI} values is presented in fig 1. Individual mean PIF_{THI} values ranged from 55 to 95 l/min, and extreme values on single days were 30–118 l/min. A PIF_{THI} of less than 40 l/min was registered in three patients in 13 out of 5248 inhalations (0·25%). Morning and evening PIF_{THI} values remained constant during the study. The mean (SD) peak inspiratory flow without the Turbuhaler at the first and last visit was 368 (108) l/min and 383 (103) l/min, respectively. The mean weekly (range) in PEF was 455 (115–726) l/min in the morning and 460 (134–733) l/min in the evening. The correlation between overall PIF_{THI} and overall PEF is shown in fig 2 (r = 0·46, p = 0·01). No statistically significant correlation between PIF_{THI} and percentage predicted forced expiratory volume in one second was found (r = 0·18, p = 0·33). All lung function parameters improved slightly, but not significantly, during the study.

Discussion

The primary objective of this study was to examine the peak inspiratory flow generated by asthmatic patients during maintenance treatment at home with a Turbuhaler (PIF_{THI}). Results were unlikely to have been affected by training as all patients were current users of the Turbuhaler for a relatively long time. However, the presence of the pneumotachograph could be regarded as a cause of improved flow rates. In our opinion this could lead to a more regular use of budesonide but probably not to an increase in the value of PIF_{THI} since verbal stimulation during the measurements at home was absent in contrast to studies performed under direct supervision. The flow through the Turbuhaler reached by the patients in our study is in accordance with other studies performed under supervision in the laboratory.10 Even though the correlation between PIF and PIF_{THI} is statistically significant in our study, it is not possible to predict PIF_{THI} accurately from expiratory variables. Previous studies have found a stronger correlation between these variables10 which might suggest that even patients with low PEF values can use the Turbuhaler effectively.

The results of this study show that asthmatic patients can produce a PIF_{THI} value of more than 40 l/min at home, which is sufficient for optimal drug delivery through the Turbuhaler.

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Notes
LETTERS TO
THE EDITOR

Lung transplantation in patients with cystic fibrosis

We read with interest the paper by Ryan et al (March 1996;51:302-5) describing their experience of pulmonary transplantation in patients referred from a single cystic fibrosis centre. We thought it would be useful to present similar data from a lung transplant centre serving several cystic fibrosis centres.

The Freeman Hospital Cardiopulmonary Transplantation Unit regularly assesses patients from six cystic fibrosis centres in the UK. To date we have assessed 137 patients on site, of whom only 12 have been considered unsuitable for transplantation. Of the 123 patients accepted, 36 have undergone pulmonary transplantation, 22 remain alive with an actuarial survival of 66% at two years and 38 have died awaiting transplantation. Fifty one patients are currently awaiting transplantation with 22 on the active list and 29 on the provisional list.

Our policy is to liaise closely with referring centres and review patients when the FEV₁ falls below 30% predicted, when there is evidence of unusually rapid and progressive fall in FEV₁ or when there is an increasing need for admission to hospital. Patients are placed on the provisional list when judged suitable for transplantation but are either too well or have correctable relative contraindications. Shortage of donor organs continues to represent the major obstacle and cause of death associated with transplantation. The median wait from acceptance to transplantation is 242 days and our experience in cystic fibrosis is that, when actively listed, approximately 50% of patients will die before surgery.

We endorse the view that it is important to discuss with potential recipients their chances of receiving lung transplantation as well as the results of this procedure.

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leagues' patients with a forced expiratory volume in one second (FEV₁) of less than 40% predicted were selected and showed improvements in exercise tolerance and quality of life after rehabilitation. Oxygen prescription during exercise was adjusted to maintain arterial oxygen saturation at 85-90% and rehabilitation continued at home after the initial in-patient programme. In a retrospective study patients with a mean FEV₁ of 20% predicted with severe hypercapnia (PaCO₂ >7.2 kPa) showed increases in exercise capacity after physical training.1

Patients with more severe COPD have a greater impairment of quality of life related to the severity of their hypoxaemia,3 and considerable anxiety and depression which further impairs activities of daily living. This patient group may be particularly suitable for home pulmonary rehabilitation programmes, although outcome measures may differ in view of the greater degree of disability present. Ambulatory oxygen devices are widely available to correct hypoxaemia during physical training and we have used these in the home without complications. More controlled studies are required to assess selection, effectiveness, safety, and costs of rehabilitation in patients with advanced COPD.


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The remainder of the book is dedicated to specific occupational lung diseases. Each chapter opens with an account of the history and a thorough review of the epidemiology before moving on to clinical and pathological aspects of the condition. The disease coverage is comprehensive rather than encyclopaedic, but this has the advantage of producing a book which is not too weighty, and which can equally be read in the library or used in the field.

For me, however, the real strength of this book is its ability to stimulate interest in, and then guide, research into occupational lung disease. This is an excellent text and is recommended. – RH

NOTICE

Pharmacology of Asthma

A course on the Pharmacology of Asthma organised by Professor Peter Barnes will be held at Imperial College School of Medicine at the National Heart and Lung Institute in collaboration with the Royal Brompton Hospital, Dovehouse Street, London SW3 6LY on 25–28 November 1996. For further details please contact the Postgraduate Education Centre, National Heart and Lung Institute, Dovehouse Street, London SW3 6LY, UK. Telephone: 0171 351 8172. Fax: 0171 376 3442.

CORRECTION

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In the paper entitled “Home assessment of peak inspiratory flow through the Turbohaler in asthmatic patients” by R J Meijer et al which appeared on pages 433–4 of the April issue there was a typographical error in the labelling on the X axis of figure 2. A correct version of the figure is reproduced below.

Figure 2. Correlation between peak inspiratory flow through the Turbohaler (PIF₂₅₀) and peak expiratory flow (PEF) at home. Data points are shown as individual means.