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Characterization of the inspiratory manoeuvre when asthmatics inhale through a Turbohaler pre- and post-counselling in a community pharmacy

G. M. Hawksworth*, L. James† and H. Chrystyn†

*Old Bank Chemist, Mirfield and †University of Bradford, U.K.

Dose emission from a Turbohaler® has been shown to be dependent on the rate of inhalation, with an optimal flow of 60 l min^{-1} recommended. Some patients may need counselling to achieve this fast inhalation. Inhalation rate profiles of 24 asthmatics were measured when they inhaled through a placebo Turbohaler®. The setting was a community pharmacy when the asthmatics came to collect their next supply of medication. Profiles were measured before and after counselling on how to use the Turbohaler. The mean (SD) peak inhalation rate through the Turbohaler pre- and post-counselling was 48·0 (16·8) and 54·7 (17·6) l min^{-1}, and their inspiratory volume was 1·75 (0·68) and 1·94 (0·62) l, respectively. Their mean (SD) percent predicted FEV_1 was 57·0 (18·9)%. After counselling, 12 patients achieved an inhalation rate of >60 l min^{-1} and a further four obtained >55 l min^{-1}. Emphasis should be placed on counselling patients prescribed all types of inhaled devices rather than concentrating on metered dose inhalers.

Key words: inhalation rate; Turbohaler; counselling.

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Introduction

It has been shown that there is a difference in the resistance between the types of dry powder inhaler devices which are available (1). Some have a low, others have a medium and the remainder have a high, resistance to inspiration. If the resistance is high, then a greater inspiratory effort is required to generate the same inhalation rate as that with a lower resistance.

In vitro studies have highlighted that the emitted dose from a Turbohaler is dependent on the inspiratory flow (2,3). Similar results have been shown by *in vivo* studies using gamma scintigraphy to visualize lung deposition (4,5). In nine asthmatics Newman *et al.* (4) reported that more terbutaline was delivered to the lungs when they inhaled through the Turbohaler at 60 l min^{-1} compared with 30 l min^{-1}; also, the bronchodilatory effect was greater at the higher rate (4). Borgström *et al.* highlighted that this phenomena was device-specific (5). Using budesonide inhaled from a Turbohaler by 10 healthy volunteers, they showed that for an inhalation rate of 58 l min^{-1} the total lung dose was 27·7% compared with 14·8% at 36 l min^{-1}.

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Correspondence should be addressed to: Professor H. Chrystyn, The School of Pharmacy, University of Bradford, Bradford BD7 1DP, U.K. Fax: +44 1274 234769; E-mail: h.chrystyn@bradford.ac.uk

Studies have shown that most asthmatic children use the Turbohaler with an inhalation rate of 30–60 l min^{-1} (6), and that this rate is dependent on age (7). A study of 59 young asthmatics has shown that when using a Turbohaler those with a higher forced inspiratory volume in 1 sec achieved more bronchodilation (8). This highlights the flow-dependent dose emission from this device which has also been indicated by suggestion of 10 stable asthmatic subjects using five different modes of inhalation (9). Peak inhalation rates could not be accurately predicted from spirometry (10).

The instructions for use leaflet supplied with a Turbohaler indicates that the inhalation should be as deep and hard as possible. This highlights the need for an optimal flow of 60 l min^{-1}. However, because of the high resistance, some patients may not be able to generate the required inspiratory effort during inhalation. In an outpatient clinic, using a Turbohaler Trainer, it has been reported that only 20% of asthmatics could achieve this rate or more (11). It may be that the patients who could not inhale at this required rate need counselling to use a deep and hard inhalation as mentioned in the patient leaflet. Patients picking up their inhaled medication from a community pharmacy will be the last contact that they have with a healthcare profession before inhaling their medication at home. We have, therefore, measured inhalation rate profiles before and after counselling when asthmatics inhale through a Turbohaler in the setting of a community pharmacy when they come to pick up their next supply of medication.

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Methods

Local ethical approval was obtained and patients gave signed written consent. Asthmatic patients (confirmed with clinic notes) leaving a community pharmacy with their inhaled medication were asked to participate as they left the premises. Those that were asked to participate were selected during the dispensing of their inhalers according to a randomization procedure. Inhalation rate profiles when patients inhaled through a placebo Turbohaler (Astra Pharmaceuticals Ltd, UK) were recorded using a method proposed by Clark and Hollingworth (1). Each inhalation profile was measured via pressure drop readings from a small probe sited in the inhalation channel of the Turbohaler. External *in vitro* assessment showed that the position of the probe did not affect the resistance or airflow through the Turbohaler. Pressure drop readings were electronically relayed every 0·1 sec into a spreadsheet to record the inhalation flow rate. These were also converted into cumulative inspired volume.

Prior to inhalation, each patient was given a copy of the inhalation instructions provided with a Turbohaler. They were not asked if they had been counselled or how to use a Turbohaler. Patients were given 10 min to read and understand the information. One inhalation rate profile, through the Turbohaler, was measured using the patient's normal inhalation technique. Patients were then counselled on the inhalation technique to be used with a Turbohaler, including instructions to incorporate a deep and fast comfortable inhalation. One inhalation profile with the Turbohaler was then measured. Spirometry was then measured as the best of three forced manoeuvres.

Results

Table 1 shows that 24 asthmatic patients, prescribed a Turbohaler, whose mean age (SD) was 55·9 (19·2) years, ranging from 10 to 76 years, completed the study. Their mean (SD) FEV_1 was 1·59 (0·55) l which is 57·0 (18·9)% of predicted with a range of 24 to 89%. Thirteen also used a metered dose inhaler, four a rotahaler and two used a diskhaler. Their mean (SD) inhalation rate profiles when inhaling through the adapted placebo Turbohaler pre- and post-counselling are shown in Fig. 1. Individual inhalation data are shown in Table 1, with a summary in Table 2. These tables show that statistically significant improvements were obtained after counselling. Pre-counselling, seven patients achieved an inhalation rate of $>60\,l\,min^{-1}$. One of these patients inhaled at a flow rate of $<60\,l\,min^{-1}$

TABLE 1. Individual data when patients inhaled with a Turbohaler pre- and post-inhalation technique counselling

Subject	Age (years)	FEV_1 (l)	FEV_1 % predicted	Peak inspiration rate ($l\,min^{-1}$)		Inhaled volume (l)	
				pre	post	pre	post
1	45	2·31	89	47·2	42·4	1·44	1·90
2	24	2·63	68	65·4	58·1	1·60	1·29
3	51	1·61	62	52·2	60·2	2·23	2·32
4	49	1·21	42	59·7	59·9	1·44	1·94
5	40	2·31	80	44·0	43·0	1·45	1·73
6	46	1·12	49	12·4	13·1	0·72	0·90
7	13	2·17	56	30·7	57·3	1·93	2·54
8	56	1·01	32	45·1	58·8	2·24	2·30
9	46	1·68	49	54·3	68·7	0·91	1·96
10	47	0·98	24	54·7	83·2	3·63	3·20
11	10	2·10	78	71·8	73·1	1·43	1·64
12	45	2·31	89	62·6	68·7	1·77	2·44
13	69	0·79	40	18·7	15·6	0·91	1·00
14	76	2·10	60	59·9	65·9	2·76	2·97
15	68	2·03	72	71·5	71·1	2·67	2·55
16	74	1·21	47	28·1	55·5	0·95	1·08
17	64	0·74	32	44·3	50·7	1·55	1·83
18	72	1·62	57	57·3	60·7	2·42	2·70
19	74	1·63	54	22·8	40·9	1·51	2·01
20	61	1·08	35	59·5	67·7	1·77	1·89
21	74	1·09	61	27·7	27·2	1·41	1·33
22	75	1·22	47	62·1	65·6	2·14	2·22
23	58	1·94	88	57·9	64·5	1·79	1·88
24	74	1·23	62	42·7	41·1	1·20	1·07

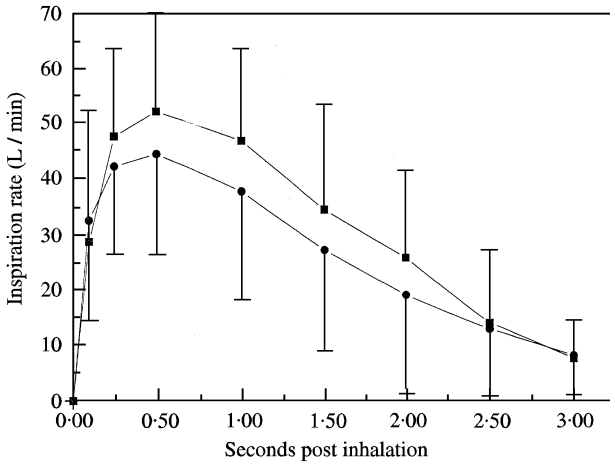

FIG. 1 Mean (SD) inhalation rate profiles through a Turbohaler before and after counselling.

post-counselling. Five other patients almost achieved $60\,l\,min^{-1}$ ($>55\,l\,min^{-1}$). Six further patients who did not achieve an inhalation rate of $60\,l\,min^{-1}$ before counselling did so afterwards. Four other patients almost achieved $60\,l\,min^{-1}$ ($>55\,l\,min^{-1}$). The mean (SD) FEV_1 % of predicted, for the 12 patients who did and did not achieve an inspiration rate of $60\,l\,min^{-1}$ after counselling were 60·3 (20·2) and 53·7 (19·4)%, respectively. The median difference (95% confidence interval) between these was −9·0 (−26·0, 10·0)%.

Conclusions

Only one inhalation was carried out pre- and post-counselling, because attempts were made to mimic clinic use. Nevertheless, it would be fair to indicate that their first attempt represents their worst and some patients are prescribed two doses. All patients were counselled to use a comfortable inhalation. This is emphasized in Fig. 1, in that the average inhalation time was 3 sec. Clark and Hollingworth (1) have stressed this. They showed that using a short sharp burst to measure a peak inspiration rate, similar to that of a peak expiration rate, provides higher values than a comfortable inhalation, but this is not the method recommended for inhalation. Dewar *et al.* (11) have reported that a higher percentage of their COPD patients could generate an inhalation rate of $>60\,l\,min^{-1}$ through the Turbohaler than these 24 asthmatics or the outpatients studied by Johnson *et al.* (12). However, Dewar *et al.* (11) indicate that the peak inspiration rates were measured by a spirometer in reverse mode to which was attached a placebo Turbohaler.

At present, emphasis is placed on training patients on how to use their metered dose inhalers, and that counselling inhalation techniques for dry powder inhalers is not necessary because they are breath-activated. The significant improvements obtained highlight the importance of counselling patients on how to use all types of inhalers. This applies more to those dry powder inhalers with a medium to high resistance whose emitted dose is affected by the inhalation rate. It is not so important for low resistance dry powder inhalers whose emitted dose is not flow-dependent.

Most of the patients were in the moderate–severe category, but they were stable and thus able to walk into the community pharmacy to collect their prescription. The inhalation rate profiles were therefore measured during a period when their asthma was well controlled. The results, therefore, probably represent the best they could achieve. During exacerbations their inspiration effort will be reduced, and thus their inhalation would be lower.

Studies have shown that patients do receive a proportion of the dose at inhalation flows of $30\,l\,min^{-1}$ (4,5). Although this is not a consistent nominal dose (2,3), the patient's dose can be titrated according to their response, and reports suggest that flow rates below $60\,l\,min^{-1}$ can give effective clinical control (4,9,13). However, variability of dose emission is increased at lower flow (2,3) and, as indicated above, any deterioration could reduce the patient's inspiratory capability, and thus the dose emitted would be decreased at a time when they require large doses delivered to their airways.

Fifty percent could achieve an inspiration rate greater than $60\,l\,min^{-1}$ which is higher than the 20% value reported for hospital outpatients (12). A further four almost managed this value. The difference to the Johnson *et al.* outpatients (12) may be that their patients were not as stable and fit as the patients who walked into the community pharmacy to take part in this study. The majority were older than 30 years, whereas studies have shown that for children the inhalation rate through the

TABLE 2. Inhalation data when using the Turbohaler ($n = 24$)

	Mean (SD)		Mean difference (95% confidence interval)	P*
	Pre-counselling	Post-counselling		
Peak inhalation rate ($l\,min^{-1}$)	48·0 (16·8)	54·7 (17·6)	6·6 (2·41,10·91)	0·0036
Inhaled volume (l)	1·75 (0·68)	1·94 (0·62)	0·20 (0·06,0·36)	0·0058
Time to peak (sec)	0·54 (0·46)	0·43 (0·23)	0·11 (−0·05,0·27)	N.S.

*t-test

Turbohaler is age related (7,14). Nevertheless, only half the patients could achieve the required rate even after counselling, and whether they would continue to use this inhalation rate is not certain. The lack of a difference in the spirometry between those who could and could not inhale at a rate of $>60\,l\,min^{-1}$ with the Turbohaler suggests that it is not easy to identify those who can achieve this inspiration rate. This highlights the lack of a correlation reported between spirometry and inspiratory values (10,15), and suggests that focus should be directed towards measurements of inspiratory effort (8). An In-Check Meter has recently been introduced. This is a simple device which can measure a patient's inhalation rates during inhalation. We have studies in progress to evaluate the use of this meter to identify which inhaled product to prescribe for each patient.

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