Assessing fullness of asthma patients' aerosol inhalers

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SUMMARY

Background. *The importance of regular medication in order to control asthma symptoms is recognized. However, there is no accurate mechanism for assessing the fullness of aerosol inhalers. The contribution to asthma morbidity of unexpectedly running out of inhaled medication is unknown.*

Aim. *A study was undertaken to determine how patients assess inhaler fullness and the accuracy of their assessments, and to evaluate the floatation method of assessing inhaler fullness.*

Method. *An interview survey of 98 patients (51% of those invited to take part), using 289 inhalers, was completed at one general practice in Hampshire.*

Results. *One third of participants said they had difficulty assessing aerosol inhaler fullness and those aged 60 years and over were found to be more inaccurate in assessing fullness than younger participants. Shaking the inhaler to feel the contents move was the commonest method of assessment. When placed in water, an inhaler canister floating on its side with a corner of the canister valve exposed to air indicates that the canister is less than 15% full (sensitivity 90%, specificity 99%).*

Conclusion. *Floating a canister in water provides an objective measurement of aerosol inhaler fullness. Providing the method is recommended by the aerosol inhaler manufacturer, general practitioners should demonstrate the floatation method to patients experiencing difficulty in assessing inhaler fullness.*

Keywords: asthma; inhalers; drug dosage.

Introduction

ASTHMA morbidity is increased by undertreatment,[1,2] poor compliance[3] and incorrect inhaler technique.[3,4] Unexpectedly running out of aerosol inhaler medication may be a further factor.[5,6] Aerosol inhalers have no mechanism for assessing their fullness, and for salbutamol, aerosols represent 81% of all inhalation devices used in the United Kingdom (Department of Health statistical bulletin, 1992).

In the absence of available data on full and empty inhaler weights the only objective way patients can assess aerosol fullness is by floating the inhaler canister in water. Previous descriptions of this method have been limited to the principle that a full canister will sink and an empty canister float.[7,8]

A study was therefore undertaken to investigate how patients assess inhaler fullness and the accuracy of their assessment, and to evaluate the usefulness of the floatation method in assessing inhaler fullness. The study was passed by the Portsmouth medical ethics committee.

Method

In 1991, aerosol inhaler users at one general practice were identified from computer repeat prescriptions and invited to the practice to be interviewed by M R. The interview closely followed written open and closed questions and M R recorded participants' answers on the interview schedule. Using 10 cm visual analogue scales, patients marked an estimate of the fullness of each of their own inhalers and a nearly empty study inhaler which was known to be less than 10% full. They were allowed to handle the inhaler in any way they wished.

Each inhaler canister was weighed on a Mettler AJ50® balance. M R then placed each inhaler canister in a glass container of water and noted its position in the water.

After the interview, inhaler fullness was calculated using predetermined full and empty canister weights which had been obtained from manufacturer information and confirmed by measurements made on three sample inhalers of each proprietary brand.

Statistical analysis[9] was carried out using the *SPSS* package.[10]

Results

Of the 194 patients asked to take part, 98 attended (51%); 44 were male. The mean age of participants was 50 years, range 5–83 years. For two children aged less than 10 years, who used spacer devices, the parents assessed inhaler fullness.

Thirty three participants (34%) stated they had difficulty assessing inhaler fullness. The percentage of participants aged 60 years or less and over 60 years expressing difficulty in assessing fullness of aerosols was similar (40% of 55 and 36% of 42, respectively) (one non-respondent).

Feeling the contents move while shaking the inhaler was the most common method of assessing fullness, reported by 83% of participants, and 42% of participants listened at the same time as shaking the inhaler (Table 1).

Table 1. Methods reported to be used by the participants to assess aerosol inhaler fullness.

	% of participants using method (n = 98)
Shake inhaler to feel contents move	*83*
Feel inhaler's weight	*52*
Listen to inhaler while shaking it	*42*
Watch inhaler's spray	*21*
Calculate fullness from duration of use	*20*
Feel strength of puff during use	*16*
Note symptom relief	*4*
Note aerosol's change of taste when empty	*2*
Do not know	*2*
Float inhaler in water	*0*

n = number of participants.

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When given the nearly empty inhaler 49 participants (50%) were within 7% of estimating its correct level of fullness. However, 15 overestimated the level of fullness by more than 25%. Participants aged over 60 years were significantly more inaccurate at assessing fullness of the nearly empty inhaler (40% of 42 overestimating by more than 15%) than those aged 60 years or less (25% of 55) (Mann Whitney U test $Z = 2.12$, $P<0.05$).

Of 54 participants whose own inhalers were more than 60% full 28 underestimated fullness by more than 15%. Eight participants (15%) underestimated fullness by more than 50%. Of 19 aerosols estimated by M R to be 0–20% full, four participants (21%) overestimated fullness by more than 15%. One woman was unaware that her inhaler was empty. Twenty two of the 289 inhalers brought by participants (8%) were past their expiry date.

Floatation data were obtained for 276 inhalers (96%). The inhaler canisters floated in four positions indicating different levels of fullness: fully immersed, indicating more than 70% full; vertically, indicating 30–70% full; on their side with the valve immersed, indicating 15-30% full; and on their side with the corner of the canister valve exposed to the air, indicating that they were less than 15% full. The ranges of inhaler fullness for each position were statistically different (analysis of variance; $F = 591.7$, 3, 272 df, $P<0.001$). This was irrespective of inhaler type for the 12 proprietary brands studied.

Of 237 canisters with their valves immersed in water, 233 were more than 15% full and four were less than 15% full. Of 39 canisters with their valves exposed to the air, three were more than 15% full and 36 were less than 15% full. A canister floating with the corner of the valve exposed to the air detected an inhaler that was less than 15% full with a sensitivity of 90% (95% confidence interval 76% to 97%) and specificity of 99% (95% CI 96% to 100%).

All sample inhalers tested had passed their licensed limit of use (200 or 400 puffs) when they floated with a corner of the valve exposed to the air. Forty of the participants' inhalers (14%) floated in this position.

Discussion

The response rate and absence of information on non-attenders is a source of bias in these results. Those patients in regular employment and the housebound may have had more difficulty attending. The study still reveals a hitherto undocumented degree of difficulty among patients about assessing inhaler fullness. Those people who overestimate inhaler fullness risk unexpectedly running out of medication and those who underestimate inhaler fullness risk wasting the aerosol inhaler by discarding it before it is empty.

The results should not be used as an argument against prescribing aerosol inhalers. Aerosol inhalers are portable, reliable, ready to use and cost effective when compared with other devices. Knowledge of inhaler fullness is just one more factor to consider when selecting the most appropriate inhaler device.

Manufacturers are divided over their attitude to floatation as a means of assessing inhaler fullness, with some actively discouraging it while others describe it in their leaflets. The main argument given against floatation is the risk of water entry into the canister. This might disrupt the valve mechanism or cause microbiological contamination of the contents. There was no evidence of water entry into the canisters in the study. On repeated immersion of 36 sample inhalers no weight gain was seen to suggest water entry and the inhalers functioned normally. However, canister labels of some brands became loose after more than 15 immersions. In view of this we advise that the number and duration of immersions should be kept to a minimum.

There are some 200 brands of aerosol inhaler produced worldwide and this study provides data only on those frequently used in one general practice. We wish to encourage manufacturers to provide information on floatation and the full and empty weights for each of their own inhalers.

In conclusion, health workers should ask if the patient has difficulty assessing aerosol inhaler fullness and, providing it is recommended by the aerosol inhaler manufacturers, offer to describe the floatation assessment method. Asthmatics should also be encouraged to keep a spare full inhaler that is within its expiry date.

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