

Original article

Technical errors in usage of inhalers among adult patients with obstructive airway disease presenting to a tertiary care center in Trivandrum, Kerala

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Abstract

Background & objectives: COPD and Asthma are common diseases causing significant mortality and morbidity. Inhaled medications are essential for proper treatment of these diseases. Poor inhaler technique is an important factor leading on to poor response to medications. Poor inhaler technique is common among asthma and COPD patients in most parts of the world. This study attempts to determine the frequency of technical errors in usage of inhalers among asthma and COPD patients. **Methods:** This was a cross sectional study with a sample size of 96 patients. Patients with COPD and asthma patients presenting to the Department of Pulmonary Medicine, Medical College, Trivandrum were included in the study. Inhaler technique of patients was checked using a checklist in a structured questionnaire. **Results:** On an average, 67% and 77% of inhaler steps were correctly performed by MDI and DPI users respectively. The type of inhaler, the setting where it was initiated, specialization of doctors who prescribed the medication and who trained the patients were found to influence the correctness of inhaler technique. **Interpretation and Conclusions:** Incorrect inhaler technique is very common and probably results from faulty training. The results of the study highlight the importance of high quality patient training on inhaler techniques.

Key words: Asthma, COPD, errors, Inhaler technique, MDI, DPI

Introduction

Obstructive airway diseases, including asthma and COPD, are leading causes of mortality and morbidity worldwide. About 235 million people currently suffer from asthma and it is the most common chronic disease among children.¹ An estimated 64 million people have COPD worldwide in 2004. It is also estimated that more than 3 million people died of COPD in 2005, which is equal to 5% of all deaths globally in that year.² About 90% of COPD deaths and most asthma-related deaths occur in low- and lower-middle income countries.^{1,2} So the proper management of Asthma and COPD is of utmost importance to countries like India so as to reduce mortality and morbidity.

There are various guidelines for the management of asthma and COPD. Most guidelines recommend the use of Inhaled medications in the pharmacologic management of acute exacerbations and management

of stable Asthma and COPD. The key inhaled drugs for asthma include inhaled gluco-corticosteroids and inhaled bronchodilators (short acting β -agonists and long acting β -agonists) whereas the key inhaled drugs for COPD include inhaled bronchodilators (short acting β -agonists and long acting β -agonists, anti-cholinergic – short and long acting) and inhaled gluco-corticosteroids.^{3,4}

Inhaled drugs are preferred for the treatment of asthma and COPD due to their high therapeutic index. These drugs are directly delivered to the airways, producing higher local concentrations and lower risk of systemic side-effects. However, unless the inhaler technique of the patient is correct, the delivery of the inhaled medication may not be optimal, and the patient may not derive the benefits of these medications. When a patient complains of lack of response to treatment offered, the major factors to be checked include the inhaler technique of the patient.

Inhaler devices differ in their efficacy of drug delivery to the lower respiratory tract, depending on the form of device, formulation of medication, particle size, velocity of the aerosol cloud and the ease with which the device can be used. Individual patient preference, convenience and ease of use may influence the efficacy of the drug delivery, patient adherence to the treatment and long term control. In those patients who can't use the inhalers properly, spacers are advised, especially in elderly people and children. Proper inhalation technique is an important factor which determines the efficacy of therapy. The International Panel of Respiratory Physicians, General Practitioners and Academicians with an interest in Asthma and Inhaler Devices was convened by International Primary Health Care Respiratory Group to discuss the science of inhalation therapy as it needs to be applied in clinical practice, particularly to highlight whether further evidence is needed to provide guidance in inhaler selection in community set up. The Group discussed that practical ways to Asthma Inhaler Technique, was the major issue in achieving Asthmatic Control. Other factors which influence the effect of Inhalers are incorrect choice of Inhalers, mixing device types, poor training, inability to use the device even after repeated training, unintentional and intentional non-adherence, doubts regarding side effects due to influence of peer group, forgetfulness, under treatment, concurrent smoking causing relative steroid resistance and co-morbidities.^{5, 6}

Studies from various countries has shown that a significant proportion of patients using inhaler devices do not have adequate inhaler technique. A systematic review of studies measuring compliance with inhaled corticosteroids, measuring inhalation technique with different inhalation devices, and estimating the proportion of inhaled drug that is deposited in the lung⁷ showed varying rates of correct inhaler technique or various devices in the studies included. The proportion of patients with good inhaler technique ranged from 5% to 86%, those with adequate technique ranged from 6% to 68% and those with poor inhaler technique ranged from 4% to 54%. The common errors noted for MDIs in this review were not shaking the inhaler (10-57%), not exhaling before actuation (15-75%), hand-breath coordination improper (17-55%) and not holding breath (24-67%). The errors with other dry powder inhalers included not exhaling before actuation (0-93%), not inhaling properly (0-41%) and improper breath hold (4-76%).⁶

Experience from Chest Disease Hospital Pulayanarkottah, Medical College Thiruvananthapuram also shows increasing number of Out-Patients and In-Patients with Obstructive Airway Diseases and that the number of patients who are in need of inhaler therapy is also increasing. Many of the patients coming to the OP and admitted in wards are not using the inhalers properly and hence a study correctness of inhalation technique among patients with Obstructive Airway Diseases using inhaler devices was planned.

Methodology

The objectives of the study were to determine the prevalence of incorrect inhaler techniques among patients with obstructive airway disease and to determine the factors associated with incorrect techniques.

A cross sectional study was conducted among the patients attending the out-patient department of Pulmonary Medicine, Medical College, Trivandrum. Patients who were already diagnosed as chronic pulmonary disease (COPD) or asthma and using inhaler medications were included in the study. Only stable patients were recruited. Those with exacerbations or those who could not use inhalers (for any reason) or those using spacer devices or those did not consent to participation in the study were excluded. Sample size was calculated based on an assumption that 50% of subjects would be using correct inhaler technique. At a precision of 20%, the sample size was estimated as 96. Subjects were recruited based on eligibility criteria and a total of 100 subjects were recruited from January to July 2011.

Information on patient characteristics was gathered using a structured questionnaire. A check list was incorporated in the questionnaire to determine the correctness of each step of inhaler use (Appendix 1). Correctness of each step of inhaler technique was estimated as proportions. The checklist for MDI use had 10 steps, each step was given a score of 1 and the total score and the percentage of correct steps (total score/10*100) was calculated for each patient. Similarly, for DPIs use the checklist had 7 steps. Each step was given a score of 1 and the total score and the percentage of correct steps (total score/7*100) was calculated for each patient. Data was entered in Ms Excel and analysed using Epi-Info version 3.5.3 version. Association between incorrect technique and risk

factors were assessed using univariate analysis and the strength of association and statistical significance expressed as odds ratio (OR) and 95% confidence intervals respectively.

Results

100 patients were recruited for the study of which 36 had Asthma and 64 had COPD. Of these patients, 46 were using Metered dose Inhalers (MDI), 53 were using Dry powder inhaler (DPI) and one was using both. The general characteristics of these patients are given in table 1.

The correctness of each step of inhaler technique was determined and expressed in proportions. The mean correctness of inhaler use was 74.33% (SD 22.62 %, median 71.43 %). Patients were classified as having good inhaler technique (80% of steps correct), adequate inhaler technique (50% to 80% of steps correct) and poor inhaler technique (less than 50% of steps correct). The proportion of patients using correct inhaler technique is shown in Figure 1. The mean of percentage of correctness of inhaler techniques among the subjects in different categories of patients is shown in table 2. The difference in means was statistically

Table 1. Baseline characteristics of study subjects

Variable	Type of inhaler*				
	DPI		MDI		
	Number	(%)	Number	(%)	
Age	below 40(n=12)	8	(67%)	4	(33%)
	40 to 50 (n=15)	9	(60%)	6	(40%)
	50 to 60 (n=27)	16	(59%)	11	(41%)
	60 and above (n=45)	22	(49%)	23	(51%)
Sex	Female (n=41)	24	(59%)	17	(41%)
	Male (n=58)	31	(53%)	27	(47%)
Inhaler prescribed by	GP (n=32)	19	(59%)	13	(41%)
	Pulmonologist (n=67)	36	(54%)	31	(46%)
Treatment initiated at	Local Hospital (n=39)	23	(59%)	16	(41%)
	Chest Disease hospital (n=60)	32	(53%)	28	(47%)
Trained by	Doctors (n=71)	36	(51%)	35	(49%)
	Others (n=28)	19	(68%)	9	(32%)
Disease	Asthma (n=36)	24	(67%)	12	(33%)
	COPD (n=61)	30	(49%)	31	(51%)
Education	Primary (n=66)	38	(58%)	28	(42%)
	Secondary (n=30)	17	(57%)	13	(43%)
	College (n=3)	-	-	3	(100%)

*One patient using on both MDI and DPI is not included in this table.

significant for the device used, who initiated the device, which place the device was initiated and who actually trained the patients. The difference was not statistically significant for age, sex, disease (Asthma / COPD) or educational status (table 2).

The incorrect steps in use of MDI and DPI use were studied separately. MDI users, on an average, performed 67% of steps correctly, whereas DPI users performed, on an average 77% of steps correctly. The lone patient on both devices could only perform

24% of steps of the two devices correctly (figure2).With MDI device, the major incorrect steps were, not correctly shaking the inhaler (55%), not holding breath correctly (57%), not exhaling properly before inhalation (62%) and not inhaling correctly (17%). The major errors for DPI device were not holding breath correctly (52%), not exhaling properly before inhalation (56%) and not inhaling correctly (56%). The correctness of major steps in patients using MDI and DPI are given in figure3and 4 respectively.

The factors associated with poor inhaler technique among MDI and DPI users were analyzed (table 3). The factors that were observed to have significant association with poor MDI inhalation technique were prescription of inhaler by non pulmonologist, treatment initiation at a hospital which is not specialized in Pulmonary Medicine and training of inhaler technique by a person other than doctor. For DPI users the only factor with a statistically significant association with poor inhaler technique was training of inhaler technique by a person other than doctor (table 3).

Table 2. Factors affecting Correctness of inhaler steps

		No. of patients	Correctness of steps of inhaler use (Mean score)	Significance for difference in means between the subgroups	
				F / t statistic	p value
Age	below 40	12	85%	1.19	0.32
	40 to 50	15	66%		
	50 to 60	28	70%		
	60 and above	45	71%		
Sex	Female	41	73%	0.104	0.91
	Male	59	72%		
Device	MDI	43	67%	7.96	<0.001
	DPI	56	77%		
	Both	1	24%		
Inhaler prescribed by	GP	33	59%	4.84	<0.0001
	Pulmonologist	67	79%		
Treatment initiated at	Local Hospital	40	57%	5.42	<0.0001
	Chest Disease hospital	60	82%		
Trained by	Doctors	72	78%	3.79	0.0003
	Others	28	57%		
Disease	Asthma	36	74%	1.51	0.13
	COPD	64	71%		
Education	Primary	67	70%	0.74	0.46
	Secondary	30	72%		
	College	3	86%		

Discussion

In this study, the proportion of patients with good inhaler technique was 45%, that with adequate inhaler technique was 33% and that with poor inhaler technique was 22%. In previous studies proportion of patients with good inhaler technique ranged from 5% to 86%, those with adequate technique ranged from 6% to 68% and those with poor inhaler technique ranged from 4% to 54%.⁷

The steps major incorrect steps are, not correctly shaking the inhaler (55%), not holding breath correctly (57%), not exhaling properly before inhalation (62%) and not inhaling correctly (17%) for MDI and not holding breath correctly (52%), not exhaling properly before inhalation (56%) and not inhaling correctly (56%) for DPI. Joseph L Rau, in his article, has reported the following proportion of patients with incorrect steps – inadequate shaking/mixing before use (13%), too rapid an inspiratory flow (19%), inadequate breath hold (26%) and lack of hand breath coordination (27%). In the same article the problems reported for DPI are not holding device correctly (35%), exhaling through mouth piece (19%), inadequate exhalation before inhaling (24%), inadequate breath hold (23%) and exhaling into mouth piece (20%). It can be seen that the steps are more incorrect in the present study.¹

There is a statistically significant difference in the mean steps performed correctly depending on device used, who initiated the device, which place the device was initiated and who actually trained the patients. This indicates that initiation of appropriate inhaler by a specialist doctor or in a specialty care centre leads on to better inhaler technique. This could be due to the fact that in such centers the doctors are better aware of the need to train patients as well as knowledgeable on how to train patients. This study indicates the need to create awareness among physicians and general practitioners the need to train patients on good inhaler technique. It also indicates the need to build capacity on training of patients for correct use of inhalers.

The editorial by Papiet. al. on the call for action in the neglected field of Inhalers for Asthma, has described the problems in teaching patients how to use inhaler devices and also the difficulties in maintaining the technique.² However for proper training of patients, the person imparting the training must know the proper technique, including refinements to optimize inhaler

therapy for each device type prescribed. However it is often seen that health providers have not mastered inhalation technique themselves and are not able to handle the varied inhalation devices currently available.^{3,4,5} In India, in the absence of trained asthma nurses and with physicians and GPs handling a large number of patients, it is often difficult to find time to train patients, particularly when the doctor is not aware of the importance of such training. In such a scenario, in India, the training or advice provided to patients would be at the level of the pharmacist dispensing the drugs, or no training at all. Bashetiet. al. have demonstrated that a simple educational intervention taking only 2.5 minutes and targeting inhaler technique was feasible for delivery by community pharmacists and resulted in improved clinical outcomes for patients with asthma.⁶

Training by pharmacists in India could be an option to improve inhaler technique among asthma and COPD patients. However training would have to be imparted in inhaler use to pharmacists.

The above mention factors are again seen when an analysis was done separately for the factors associated with poor inhalation technique in patients using MDI and those using DPI. Among MDI users the factors with a statistically significant association with poor inhalation technique are prescription of inhaler by non pulmonologist, treatment initiation at a hospital which is not specialized in Pulmonary Medicine and training of inhaler technique by a person other than doctor. For DPI users the only factor with a statistically significant association with poor inhaler technique was training of inhaler technique by a person other than doctor. This makes it clear that patients being initiated on MDI need better training, in the current scenario from a specialist, to avoid poor technique. For both MDI and DPI, the training given at the time of initiation seems most important. In a country like India, it may not be feasible to initiate inhalers only at the level of specialists, but special care may be needed to the group of patients who are initiated on Inhaled medications by non-specialists / non-specialty hospitals, and the inhalation technique of such patients may need more close monitoring and review.

The current study is limited by the following facts. It has been conducted in a government tertiary care centre so that there is a preponderance of patients with lower levels of education and lower socio-

economic strata. The population studied, hence, may not be representative of the population. Also the factor that the study setting is a academic hospital means that the patients in this centre have greater opportunities of getting trained before inclusion in this study and hence are more likely to have a better inhaler technique than those being treated in a peripheral / non-academic institution. Another limitation of the study is that the scoring system used gives the same importance to both crucial steps and less important steps. Hence a patient with a high proportion of steps correct, may actually have poor drug delivery as he may be doing

a key step very poorly. A grading system for each step, with extra weightage for the crucial steps might have to be attempted in the future studies for better results.

Conclusions

Incorrect inhaler technique is very common and probably results from faulty training. The results of the study highlight the importance of high quality patient training on inhaler techniques and also increasing awareness among care providers regarding the necessity for proper training before initiating inhalers.

APPENDIX: 1

Check list for assessing technique of MDI

- | | |
|--|--------------------------------|
| 1. Shaking MDI immediately before use: | Yes / No |
| 2. Exhaling fully before activating the MDI: | Yes / No |
| 3. Holding mouth piece tightly around lips & avoiding | Yes / Noobstruction by tongue: |
| 4. Keeping the MDI with longest part pointing upwards: | Yes/No |
| 5. Activating inhaler only once with a single inhalation: | Yes / No |
| 6. Inhalation and start of breathing coordinated: | Yes/No |
| 7. Slowly inhaling after activating Inhaler: | Yes/No |
| 8. Continue to inhale fully without interruption after delivery of dose: | Yes/No |
| 9. Holding breath for at least 10 sec/ as long as possible: | Yes / No |
| 10. Wait for 1-2 minutesfor taking second puff: | Yes/No |

Check list for assessing thetechnique ofusing DPI

- | | |
|--|--------|
| 1. Keep the DPI upright for insertion of capsule | Yes/No |
| 2. Insert capsule with transparent end down | Yes/No |
| 3. Keep the DPI horizontal | Yes/No |
| 4. Exhale to residual volume after deep inhalation | Yes/No |
| 5. Place the mouth piece of DPI between teeth and lips | Yes/No |
| 6. Adequate inhalation (force and depth) | Yes/No |
| 7. Hold breath for 10 seconds | Yes/No |

References

1. WHO Media center, Asthma, Fact sheet. May 2011 – accessed from <http://www.who.int/mediacentre/factsheets/fs307/en/index.html> on 30-06-2012
2. WHO Media center, COPD, Fact sheet. November 2011 COPD fact file – accessed from <http://www.who.int/mediacentre/factsheets/fs315/en/index.html> on 30-06-2012
3. *Global Strategy for Asthma Management and Prevention*, Global Initiative for Asthma (GINA) 2011, page 29 - 33
4. *Global Strategy for the Diagnosis, Management and Prevention of COPD*, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2011, page 21 - 25
5. Mariëlle EAC Broeders, Walter Vincken, Lorenzo Corbett et al. *Prim Care Resp J* 2009; 18(2): 76-82.
6. Jane Clatworthy, David Price, Dermot Ryan, John Haughney, Rob Horne et al. *Prim Care Resp J* 2009; 18(4): 300-305
7. Cochrane MG, Bala MV, Downs KE, Mauskopf J, Ben-Joseph RH, Inhaled corticosteroids for asthma therapy: patient compliance, devices, and inhalation technique. *Chest* 2000; 117: 542–550
8. Joseph L Rau, Practical Problems With Aerosol Therapy in COPD. *Respiratory Care* • February 2006 Vol 51 No 2: 158 – 172
9. Papi, J. Haughney, J.C. Virchow, N. Roche, S. Palkonen, D. Price; Editorial: Inhaler devices for asthma: a call for action in a neglected field *EurRespir J* 2011 37:982-985; doi:10.1183/09031936.00150910
10. Burton AJ, Asthma inhalation devices: what do we know? *Br Med J (Clin Res Ed)* 1984; 288: 1650–1651.
11. Interiano B, Guntupalli KK, et. al. Metered-dose inhalers. Do health care providers know what to teach? *Arch Intern Med* 1993; 153: 81–85.
12. Broeders ME, Sanchis J, Levy ML, Dekhuijzen PN; et al. The ADMIT series: issues in inhalation therapy. 2. Improving technique and clinical effectiveness. *Prim Care Resp J* 2009; 18: 76–8
13. Basheti IA, Reddel HK, Armour CL, Bosnic-Anticevich SZ. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. *J Allergy ClinImmunol.* 2007 Jun;119(6):1537-8. Epub 2007 Apr 16