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Assessment of inhalation technique of bronchial asthma and chronic obstructive pulmonary disease patients attending tertiary care hospital in Jaipur, Rajasthan

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Abstract

Context: Prevalence of chronic obstructive pulmonary diseases (COPD) and bronchial asthma is on the rise all over the world. Inhalation therapy is the most recommended and efficient therapy for these respiratory diseases, but incorrect inhalation technique can cause poor disease control and increase the burden on health care resources. **Aims:** The aim was to evaluate the inhalation technique of COPD and bronchial asthma patients using pressurized metered dose inhaler and to investigate the determinants of incorrect inhalation technique. **Settings and Design:** Hospital-based cross-sectional study. **Subjects and Methods:** Consecutive nonrandom sampling method was used to enroll study subjects. Basic sociodemographic information of the study subjects was collected. The inhalation technique was visually observed and scored on checklist. **Statistical Analysis Used:** Chi-square test and Fisher exact test. **Results:** Among the 85 patients observed, 64 (75.29%) were males. Correct technique was observed in only 18 (21.17%) patients. The step at which maximum number of patients committed mistake was exhalation (65.88%) followed by breath holding (45.88%). No significant correlation was found between accuracy of the technique and the guide who taught the technique, age, sex, education status, or area of residence of the patients. A significant correlation ($P = 0.002$) was found between duration of device usage and correctness technique. **Conclusions:** It was found that substantial errors were made in the inhalation technique hence proper training and follow-up of the patients is required to achieve the desired effects of the inhaled medications.

Keywords: Bronchial asthma, chronic obstructive pulmonary diseases, inhalation technique, pressurized metered dose inhaler

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Introduction

Chronic respiratory diseases which include asthma and chronic obstructive pulmonary diseases (COPD) may account for an estimated burden of about 100 million individuals in India . [1] The prevalence of COPD in India is on the rise and epidemiological data on asthma show a low level of disease control in many countries, including India. [2] Proper disease control is a collective outcome of appropriate prescription of medication, monitoring of disease progression, and modification of treatment as and when required.

Over the decades, inhalation therapy has become the backbone in the treatment of these disorders, although new inhalers have been designed to improve ease of use, significant rates of incorrect use have been reported among COPD and bronchial asthma patients, even among regular adult users . [3] This not only undermines the patient compliance, but also dwindles the effectiveness of these devices on a large scale. Incorrect use leads to poorer control of symptoms due to insufficient drug delivery and inefficient lung deposition and higher rates of asthma instability and increased burden on emergency services.

Our study evaluates the inhalation technique in COPD and bronchial asthma patients using pressurized metered dose inhalers (pMDI) attending a tertiary care hospital for respiratory diseases in Jaipur. The main aim of this study was to find out the steps at which the patients made the maximum number of mistakes while using pMDI and to examine determinants of incorrect technique.

Subjects and methods

A cross-sectional study was carried out during November 2013 among indoor and outdoor patients of COPD and bronchial asthma in a tertiary care hospital for respiratory diseases in Jaipur. A sample size of 85 was estimated, and patients were chosen by consecutive nonrandom sampling method till the required sample size was reached. Bronchial asthma patients using pMDI were included in the study. Patients above 18 years of age who had been using pMDI for at least 6 months were included in the study. Those patients with recurrent exacerbations, chronic infections and those using spacer devices or other inhalation devices were excluded from the study. All participants were informed about the study and signed a written consent form of participation.

The study involved collection of the basic sociodemographic information and visual observation of the inhalation technique of the patients and scoring of their technique on the inhaler specific checklist simultaneously by two observers. The technique of inhalation was divided into 7 steps, namely shaking, positioning, exhalation, actuation, hand mouth coordination, slow deep inhalation, breath holding. With a view, that each of these steps is crucial for effective delivery of the drug to the lung and also for instant onset of action.

Note was also made of the person who taught the patient the technique at first place and a correlation between efficiency of the technique and guide was looked for. Individual steps for inhalation and their criteria for correctness are summarized in [Table 1]. [4]

Table 1: Description of each step involved during inhalation of medication using pMDI
Step 1: Shaking
Step 2: Positioning
Step 3: Exhalation
Step 4: Actuation
Step 5: Hand mouth coordination
Step 6: Slow deep inhalation
Step 7: Breath holding

Table 1: Description of each step involved during inhalation of medication using pMDI

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Results

Among the 85 patients observed, 64 (75.29%) were males. The mean age of the patients was 44.9 ± 1.9 years. Nearly, 52% of the patients were from the rural background, and the number of illiterate patients were 47 (55.29%). Forty nine patients (58%) had COPD, and 36 patients (42%) had bronchial asthma. The mean duration of disease was 1.25 years and the, mean duration of usage of the device was 1.15 years.

In our study, for 47 patients (55.29%) [Table 2] doctor played the role of mentor, the nurse in 21 patients (24.70%), whereas 10 patients (11.76%) had learnt the methodology from their neighbors/relatives. The pharmacist was the mentor in two patients (2.30%), while five patients (5.80%) learned the technique by themselves through brochure.

Variables	Correct	Incorrect	Total	P
Age (years)				
<40	15 (35.7)	27 (64.3)	42 (100)	
40-50	10 (23.8)	32 (76.2)	42 (100)	
>50	12 (27.9)	31 (72.1)	43 (100)	
Sex				
Male	31 (71.8)	12 (28.2)	43 (100)	
Female	16 (36.4)	28 (63.6)	44 (100)	
Education				
<10	15 (35.7)	27 (64.3)	42 (100)	
10-12	10 (23.8)	32 (76.2)	42 (100)	
>12	12 (27.9)	31 (72.1)	43 (100)	
Duration of use (years)				
<1	15 (35.7)	27 (64.3)	42 (100)	
1-5	10 (23.8)	32 (76.2)	42 (100)	
>5	12 (27.9)	31 (72.1)	43 (100)	
Residence				
Urban	15 (35.7)	27 (64.3)	42 (100)	
Rural	10 (23.8)	32 (76.2)	42 (100)	
Occupation				
Student	15 (35.7)	27 (64.3)	42 (100)	
Worker	10 (23.8)	32 (76.2)	42 (100)	
Unemployed	12 (27.9)	31 (72.1)	43 (100)	
Others	15 (35.7)	27 (64.3)	42 (100)	

Table 2: Patient characteristics and correlation with inhalation technique

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We found that only 21% of the patients were able to perform inhalation technique correctly, and a total of 67 patients (78.82%) performed at least one step incorrectly. In our study, the step at which maximum number of patients committed mistake was exhalation (65.88%) [Figure 1] followed by breath holding (45.88%). Multiple actuations were seen in 43.53% of the patients. It was also found that patients who had been using the device for longer duration performed the technique correctly ($P = 0.002$). No significant correlation could be drawn between age, sex, education level, area of residence, and the correctness of the inhalation technique.

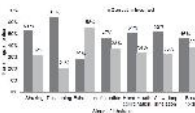


Figure 1: Performance of individual steps by patients using pressurized metered dose inhalers

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Discussion

Among 85 patients, 75% were males. The mean age of study subjects was 44.9 ± 1.9 years. Fifty-eight percent of the patients had COPD, and 42% had bronchial asthma. For 55% of the patients, doctor played the role of guide, 24.70% patients were taught by nurses and rest of the patients had been taught the technique by relatives, neighboring patients, and pharmacists.

The study is the first of its kind performed in Jaipur and highlights not only the importance of demonstration of correct technique to the patients but calls attention to the critical steps which the patient might be performing wrong, so that these particular steps in inhalation technique can be rectified and emphasized for better relief of the symptoms. This would not only assist in improving the patient compliance but also enhance the patient as well as a physician's confidence in the therapy.

Due to time constraints and convenience, a consecutive sampling was undertaken. Study focuses on assessment of only pMDI though large number of patients also uses dry powder inhaler and other devices. The present study tries to bring in the much required focus on assessment of the inhalation technique during prescription of inhalation devices.

Pressurized metered dose inhaler presents a clear challenge for a patient with respiratory disease who has to comprehend and execute the steps, which involve simultaneous coordination of respiratory and motor movements. We found that only 21% of the patients were able to perform inhalation technique correctly as we evaluated the technique by visual observation and scored it on the checklist. A total of 67 patients (78.82%) performed at least one essential step incorrectly. The considerable number of mistakes regarding inhalation technique as observed in our study is in line with previous studies.

Study done by Buckley [5] reported that only 18 out of 71 patients (25%) had perfect technique, 26 (37%) had adequate technique and 27 (38%) had poor technique and the patients most likely to have poor technique were those using a MDI. A study done by Molimard *et al.* [6] also reported similar results that at least 76% of the pMDI users made >1 mistake.

In our study, the initial education on inhaler use was predominantly provided by doctors (55%) followed by trained nurses (24.70%) and around 12% of the patients were taught by relative, or a neighboring patient. Approximately, 6% of the patients had self-taught the technique with the help of brochures. Only 2% of patients received their initial training from pharmacists. This highlights the varied spectrum of guides the patient comes in contact with and also calls attention to the fact that proper training of the healthcare team like staff nurses and pharmacists could help in patient education and improvement and implementation of the technique at grass root level as it is not feasible to always initiate the initial training at the level of specialist. It is also important that the technique of patients who have received training from nonspecialists should be closely monitored and periodically reviewed.

This can also lead to confusion among health professionals over who should take responsibility for patient education can result in people not receiving follow-up education on the correct use of their inhalers, contributing to high rates of poor technique as reported in the literature. Hence, a structured system and follow-up protocols should be formed and implemented.

In our study, the step at which maximum number of patients committed mistake was exhalation (65.88%) followed by breath holding (45.88%). Multiple actuations were seen in 43.53% of the patients. In a recent study from Trivandrum, [7] authors found that the major incorrect steps were, not exhaling properly before inhalation (62%), not holding breath correctly (57%), not correctly shaking the inhaler (55%), and not inhaling correctly (17%) for pMDI. In another study by Rootmensen *et al.*, [8] for the pMDI the steps concerning hand-lung coordination; that is, "activate canister in beginning of a slow inhalation" and "continue to inhale slowly and deeply," were most frequently performed incorrectly (respectively, 72 and 31%). In a study conducted in Turkey [9] also it was found that the most common basic error

associated with inhalation maneuvers was failure to exhale before inhaling through the device (18.9%). Research studies [10] show that it is very important for patient to exhale normally until functional residual capacity is reached and then take a slow, but deep breath and hold it for at least 10 s for maximum drug penetration into the airways. Multiple actuations do not provide any benefit as the subsequent pumps do not carry medicine as the necessary pressure does not build up and also patient ends up exhaling medicine from first actuation before inhaling deeply.

There are various factors which can influence the patient's adaptation to the inhalation technique such as literacy level of the patient, which affects the comprehension of the technique, type of instructor who taught the technique which affects the correctness of technique at the preliminary level. In our study, frequency of efficient technique varied from 20% to 50% in different groups of instructors. Though no significant correlation was found between correctness of technique and education level in our study ($P = 0.29$), but illiteracy [11] may have a role in faulty technique, education, and regular reinforcement can definitely ensure a more precise technique.

It was found that patients with a longer duration of device use (>1 year) had significantly better technique of inhalation ($P = 0.002$) than patients who had used the device for shorter duration (≤ 1 year). This may possibly represent an improvement in the level of understanding of the device usage on the part of the patient by interaction with multiple physicians, nurses, and fellow patients.

It was found that only 21% of the patients who had received training from the doctor had correct technique. It could be due to lack of reinforcement of the technique and periodic observation in subsequent visits that could have ensured that patients maintained adequate technique or it could be deficits in technique of the physicians themselves that could lead them to often choose to not to instruct the patient. Simply asking the patient whether they are using an inhaler properly is not sufficient as proficiency in good technique tends to decrease over time and patient might introduce errors unknowingly hence repetitive education is important.

We also observed that around 2% of the study population had been taught by pharmacists and patients taught by them showed considerable competence in the technique. Previous studies [12] have shown that when pharmacists who are proficient in asthma management, including inhaler technique, work with physicians to optimize the education and overall management of patients with asthma, better outcomes often result, including a reduction in both emergency department visits and hospitalizations. Hence, the inclusion of pharmacists in the health care team and their training in proper technique and follow-up observation could go a long way in improving patients skills of inhalation and hence efficacy of treatment.

We conclude that substantial errors were made by patients using pMDI as the inhalation device. Teaching proper technique will not only improve patient's compliance but also will lead to better disease control and lesser cost and stress on emergency medical services. Though it is the primary responsibility of the physician prescribing the inhaler to provide patient with proper instructions for using the device, but the responsibility could also be branched among the health care team like pharmacists who could play a vital role in teaching and reinforcing the technique. Careful follow-up of these patients is necessary, and if still patient has faulty technique then change of prescription could also be considered.

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Name of the step	Criteria for correctness of the step of inhalation for pMDI
Shaking the device	Shaking inhaler 3-4 times before each puff to mix the drug particles that have settled in the pump
Positioning	Holding the device firmly upright between thumb and forefinger, inserting the mouthpiece into mouth and sealing lips around it
Exhalation	Exhaling to FRC or exhaling normally. This will help prepare to take a deep breath in
Actuation	Pressing the canister once to release the drug
Hand mouth coordination	Inhaling slowly through mouth, pressing down once on the pump at the same time
Slow deep inhalation	Inhaling slowly until TLC and then breathing in slowly and deeply
Breath holding	Patient should try and hold the breath for at least 10 s

pMDI - Pressurized metered dose inhaler, TLC - Total lung capwacity, FRC - Functional residual capacity

Determinants of the technique	<i>n</i> (%)	Evaluation of inhalation technique		
		Completely correct <i>n</i> (%)	Completely incorrect <i>n</i> (%)	<i>P</i>
Age* (years)				
≤40	31 (36.47)	8 (25.8)	23 (74.1)	0.42
>40	54 (63.52)	10 (18.51)	44 (81.48)	
Sex*				
Male	64 (75.2)	12 (18.7)	52 (81.2)	0.33
Female	21 (24.7)	6 (28.5)	15 (71.4)	
Area of residence*				
Urban	36 (42.3)	10 (27.7)	26 (72.2)	0.20
Rural	49 (57.6)	8 (16.3)	41 (83.6)	
Education status*				
Literate	47 (55.2)	8 (17)	39 (82.9)	0.29
Illiterate	38 (44.7)	10 (26.3)	28 (73.68)	
Disease*				
Bronchial asthma	36 (42.3)	9 (25)	27 (75)	0.45
COPD	49 (57.6)	9 (18.3)	40 (81.6)	
Duration of use† (year)				0.002‡
≤1	42 (49.4)	3 (7.1)	39 (92.8)	
>1	43 (50.5)	15 (34.8)	28 (65.1)	
Guide†				
Doctor	47 (55.2)	10 (21.2)	37 (78.7)	0.55
Nurse	21 (24.7)	3 (14.2)	18 (85.7)	
Others	17 (20)	5 (29.4)	12 (70.5)	

*Chi-square test, †Fisher exact test, ‡Result is significant at $P < 0.05$ at 95% CI. CI - Confidence interval, COPD - Chronic obstructive pulmonary disease

