ORIGINAL ARTICLE

To Study the Effectiveness of Inhalation Technique Training in Patients with COPD and Asthma

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Received: 11 December 2022; *Accepted:* 16 February 2023

Abstract

Introduction: Asthma and chronic obstructive pulmonary disease (COPD) are characterized by chronic airway inflammation. Lack of knowledge about the correct inhalation techniques leads to poor control of both diseases. This study aimed to study the effectiveness of inhalation technique training in patients with COPD and asthma.

Materials and methods: A total of 132 patients fulfilling the inclusion criteria were trained with the correct technique of inhalation on day 0 and at the end of 1 and 6 months. Evaluation of technique training was done on these three occasions posttraining. The mean score of devices was obtained, and the mean inhalation technique score of various devices was compared.

Results: Out of 132 patients, 65.1% (86/132) patients were using a dry powdered inhaler (DPIs), 26.5% (35/132) patients used metered dose inhalers (MDIs), and 8.4% (11/132) patients used MDI with spacer. The mean scores of patients using MDI at baseline were 5.68 ± 0.83, and after 1 month, 6.68 ± 0.58 ($p < 0.000$). The inhalation technique mean score of MDI improved after 6 months, 7.02 ± 0.56 as compared to baseline ($p < 0.008$) mean score of the patients using DPIs improved after 1 month, 5.53 ± 0.58 as compared to baseline 4.37 ± 5.53 ($p < 0.000$). There was no statistical improvement in the device mean score of DPIs after 6 months, 5.62 ± 0.55 when compared with 1 month, 5.53 ± 0.58 ($p < 0.117$). Patients who used pressurized metered-dose inhalers (pMDI) with spacers improved their inhalation score after 1 month by 6.90 ± 0.94 as compared to the baseline score of 6.90 ± 0.94 ($p < 0.001$). The mean score decreased marginally after 6 months, 7.818 ± 0.60, as compared to the score at the end of 1 month of 8.27 ± 0.64 ($p < 0.053$).

Discussion: Patients showed improvement in the technique of inhalation after educational training, reinstructions, and a standard checklist.

Journal of the Association of Physicians of India (2023): 10.5005/japi-11001-0238

Introduction

Chronic obstructive pulmonary disease (COPD) is defined as a heterogeneous lung condition characterized by chronic respiratory symptoms of dyspnea, cough, sputum production, and exacerbations due to abnormalities of the airways (bronchitis and bronchiolitis) and/or alveoli (emphysema) that causes a persistent, often progressive, airflow obstruction.[1] Severity of COPD in an individual is proportional to the exacerbations and comorbidities. Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation and a history of respiratory symptoms such as wheezing, shortness of breathe, chest tightness, and cough that vary over time and in intensity, together with variable expiratory airflow limitation.[2] The core of the treatment for both these chronic entities lies in the right inhalation therapy with a proper technique that delivers the drug directly to the diseased site and provides the largest results with the slightest of adverse effects. On the contrary, there are some associated disadvantages with inhalation therapy as well, which results due to improper inhalation technique by the patients.[3] The right inhalation technique is essential to deliver the required amount of inhaled drug to the airways and improve the drug's efficacy. However, the fallacious inhalation technique is very much common in patients with chronic airflow limitation[3–6]; hence right training is a must for all these patients to ensure maximal delivery of the inhaled drug.[7–9] A substandard inhaler technique has been exhibited by many patients using both MDIs as well as DPIs. Various studies have revealed that to achieve a flawless inhalation technique, both written and verbal instructions along with stepwise inhalation training and further assessments of this technique are necessary to achieve good results. This applies to all inhaler devices, including the breathe-actuated ones.[10] The primary aim of this study was to improve the inhaler technique by imparting education on the inhalation technique to the patients.

Materials and Methods

The study was a follow-up observational study that included patients of COPD and bronchial asthma using any of the inhalation devices and attending outpatient clinics at the National Institute of Tuberculosis and Respiratory Diseases, Delhi, India.

The inclusion criteria for the study were:

- Diagnosed cases of COPD or bronchial asthma, who were using any inhalation device.
- Age 15–60 years.
- Signed consent form.

The exclusion criteria of the study were:

- Age <15 or >60 years.
- Patients having active infection of tuberculosis.
- Any associated comorbid condition which may hinder inhalation device use.
- Patients who are not willing to be a part of the study.

A total of 176 patients were taken up for the study, 40 patients did not turn up for further assessments, and they were excluded from the study, and 132 patients were analyzed. Patients fulfilling the inclusion criteria were given correct inhalation technique training on day 0 and at the end of 1 month. Evaluation of inhalation technique was done on three occasions—at baseline, at the end of 1 month, and 6 months posttraining. A score of 1 was given to each of the step performed correctly for different devices (maximum score for MDI—9, for DPI—7, and MDI with spacer—10). The mean score of devices was obtained at baseline, at the end of 1 and 6 months and the impact of education was analyzed. The personal data included were age, sex, residence, diagnosis, education, matrimonial status, occupation, type, frequency of the inhalation device used, and previously who imparted inhalation technique.

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How to cite this article: Meena M, Arora P, Goud MS, *et al.* To Study the Effectiveness of Inhalation Technique Training in Patients with COPD and Asthma. J Assoc Physicians India 2023;71(5):56–60.

All inhalation technique training was given by the same investigator to exclude interobserver reliability. An Statistical Package for the Social Sciences version 20.0 was used to perform the statistical analysis. To analyze the various answers provided in the patient proforma Chi-squared test and Fisher's exact test were applied. Paired *t*-test and analysis of variance test were done for comparison of mean scores of inhalation technique at baseline, at the end of 1 and 6 months. The included patients were then evaluated for the inhalation technique and steps as elaborated in the literature review by the European Respiratory Society.[11] Table 1 shows the checklist for various devices.

Results

A total of 176 patients were enrolled in the study; 40 patients did not turn up for follow-up and were excluded. The remaining 132 patients were analyzed. Out of 132 patients, 65.1% (86/132) patients were using DPI, 26.5% (35/132) patients used MDI, and 8.4% (11/132) patients used MDI with spacer. The mean age observed was 41.9 years. Males constituted 65.1% (86/132) of the total study population, and 34.9% (46/132) were females. DPI was the most used device among both males and females (68.6 and 58.6%, respectively). The COPD group comprised 77 patients out of 132 (58.4%), and the bronchial asthma group comprised 55 out of 132 (41.6%). A total of 58 patients (44%) had learnt the inhaler technique from the chemist, 51 patients (38.6%) from hospital staff, 13 patients (9.8%) learnt on their own, and only 10 patients (7.6%) learnt from a doctor. It was observed that 95 patients (72%) were using the device regularly, while 37 patients (28%) were using the device irregularly and on a needed basis. Details of both the COPD and asthma group patients and their characteristics are summarized in Table 1A.

In our study inhalation technique score of the patients using MDI in our study at baseline was 5.68 ± 0.83, which was increased to 6.68 ± 0.58 ($p < 0.0001$) and it is 7.02 ± 0.56 after 6 months and $p < 0.0001$ as compared to baseline (Fig. 1). Asthma patients had better baseline inhalation technique as compared to COPD patients (Fig. 2) with mean scores of 4.54 ± 0.91 and 5.472 ± 1.16, respectively. The baseline mean inhalation technique score of the patients who were illiterate was 4.57 ± 0.91, primary school 4.55 ± 0.60, mid-school 4.88 ± 1.01, high school 5.92 ± 1.11, intermediate 5.6 ± 0.89, and for graduates score was 6.4 ± 1.51 implying that literates have better inhalation technique than illiterates (Fig. 3). The mean percentage improvement of MDIs in our study was 63.1% at baseline, 74.2% at 1 month, and 78 % at 6-month follow-up. The mean score of the inhalation technique of patients using DPIs in our study was 4.37 ± 0.70 at the baseline and 5.53 ± 0.79 after 1 month of education. The mean percentage improvement of DPIs in our study was 61.4% at baseline, 79% at 1 month, and 80.2% at 6-month follow-up. In this study, patients who used pMDI with spacers showed improvement in their inhalation score after 1 month, 8.27 ± 0.64 (82%) as compared to the baseline score of 6.90 ± 0.94 (69%) ($p < 0.001$) technique. Figure 4 depicts the inhalation steps failed by patients using various inhalation devices.

Table 1: Checklist of inhalation steps for various devices

MDI suggested checklist	*DPI suggested checklist*	*MDI with spacer suggested checklist*
• Remove the cap. • Hold the inhaler with the canister upside and shake properly before use. • A gentle expiration to blow the air out. • Inhaler mouthpiece to be held tightly between teeth and lips without biting and ensure a good seal. • Push the canister down forcefully and start to breathe in the drug gently through the mouth to the maximum. • Continue to breathe in deeply to the maximum. • Breathe holding for 5–10 seconds is required. • Remove the device away from the mouth during the breathe holding period. • Lastly, breathe out gently once the mouthpiece is removed.	• Remove cover. • Load dose and pierce capsule. • Breathe out away from the mouthpiece. • Put the DPI mouthpiece between teeth and lips without biting and ensure a good seal. • Take a deep and slow breathe into the maximum. • Breathe holding for 5–10 seconds is required. • Remove the device from the mouth. • Lastly, breathe out gently once the Inhaler device is removed.	• Remove the inhaler cap. • Hold the inhaler with the canister upside and shake properly before use. • Insert inhaler with canister upside into the mouth of spacer. • Breath out gently. • Put the spacer mouthpiece tightly between teeth and lips without biting and ensure a good seal. • Hold the spacer firmly with one hand and press down forcibly on the canister once with the other hand. • Take slow and deep breaths inside and hold your breathe for 5–10 seconds. • Remove the spacer away from the mouth during breathe holding. • Breathe out gently. • Remove the inhaler from the mouth of the spacer and put cover caps on both device and the spacer.

Discussion

In the present study, we analyzed the effectiveness of education and training on patient inhalation technique in diagnosed cases of COPD and bronchial asthma, and results were analyzed at baseline, 1 and 6 months, respectively. Asthma and COPD are both preventable and treatable chronic respiratory diseases if the patient adheres to the treatment and uses a proper drug delivery technique. The maximal response elicited by any inhaled drug can be achieved only if the delivery technique is optimal. A poor inhalation technique with missed steps leads to subtherapeutic drug response, which subsequently leads to more adverse effects and, lastly, therapy discontinuation, thus adding to the mortality and morbidity caused by these chronic respiratory diseases. Both Global Initiative for Chronic Obstructive Lung Disease and Global Initiative for Asthma guidelines have highlighted the critical importance of inhaler technique and education on patients taking inhalation drug therapy. This needs a collaborative drive to educate healthcare professionals and patients and make them aware of how a proper inhalation technique can improve their level of disease control and lessen the side effects. In this study, asthma patients had a better baseline inhalation technique and critical errors were less in them as compared to COPD patients. A study done by Souza et al.[8] also found that COPD patients committed more errors as compared to bronchial asthma patients. This inference was similar to our study. The study conducted by Melani et al.[5] also concluded that bronchial asthma patients had a lower risk of critical errors than COPD patients. The available literature cited above reveals that the critical errors committed by patients in inhalation steps are different in COPD and asthma patients, and errors also vary with the type of device used.

The level of education plays a very pivotal role in how the patient starts inhalation therapy for the first time. A study done by Pothirat et al.[13] found that low education level was an important factor related to incorrect technique, and in our study also, illiterate patients committed far more errors as compared to graduates. A study done by Coelho et al.[7] also found that the risk of errors increased with a lower level of education.

Inhalation technique scores of the patients using MDI increased to 6.68 ± 0.58 ($p < 0.0001$)

Table 1A: Characteristics of the patients

Characteristics	*Patients using MDI*	*Patients using DPI*	*Patients using MDI with a spacer*	*Total*
Number of patients	35 (26.5%)	86 (65.1%)	11 (8.4%)	132
Age (year)				
Mean				41.9
Range				16–60
Sex Distribution (%)				
Male	21 (24.4%)	59 (68.6%)	6 (6.9%)	86 (65.1%)
Female	14 (30.4%)	27 (58.6%)	5 (10.8%)	46 (34.9%)
Diagnosed cases of				
COPD and	14 (18.2%)	61(79.2%)	2 (2.6%)	77 (58.4%)
bronchial asthma	21 (38%)	25 (45.6%)	11 (16.4%)	55 (41.6%)
Inhabitance				75 (56.8%)
Rural	16 (21.3%)	55 (73.4%)	4 (5.4%)	57 (43.2%)
Urban	19 (33.4%)	31 (54.4%)	7 (12.2%)	
Duration of Device use (year)				
<1	20 (34.5%)	28 (48.3%)	10 (17.2%)	58 (25.2%)
1–2	4 (13.4%)	26 (86.6%)	0 (%)	30 (25.2%)
2–5	3 (16.7%)	15 (83.3%)	0 (%)	18 (25.2%)
>5	8 (30.7%)	17 (65.3%)	1 (4%)	26 (25.2%)
Educator				
Self	8 (61.5%)	2 (15.3%)	3 (23.2%)	13 (9.8%)
Chemist	15 (25.9%)	41 (70.7%)	2 (3.4%)	58 (44%)
Hospital staff	9 (17.6%)	40 (78.5%)	2 (3.9%)	51 (38.6%)
Doctor	3 (30%)	3 (30%)	4 (40%)	10 (7.6%)

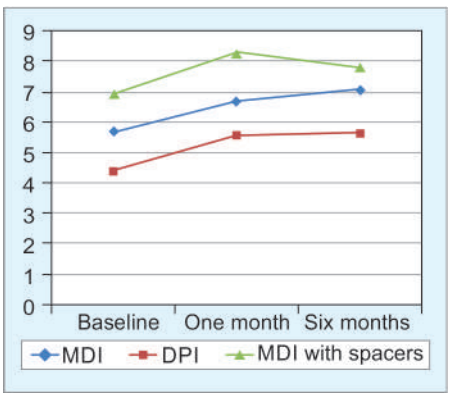

Fig. 1: Mean Score of inhalation devices at baseline, 1 month and 6 months

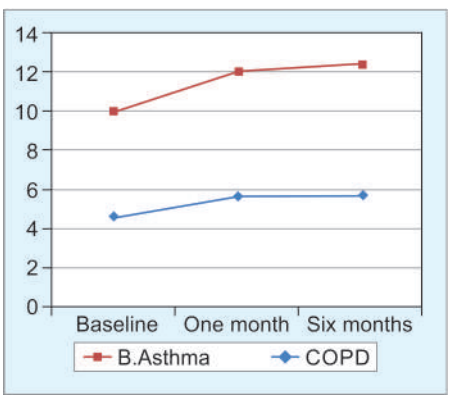

Fig. 2: Inhalation technique scores in COPD and Asthma patients

after training in our study, and it was 7.02 ± 0.56 after 6 months ($p < 0.0001$), which was statistically significant. In a study conducted by Basheti et al.,[14] the improvements in mean scores before and after training for MDI were 4.77 ± 1.60 vs 8.77 ± 0.52, respectively. The high mean score after training in their study could be because of a better understanding of devices by participants, as most of them were doctors, nurses and pharmacists. In a similar study conducted by Bosnic et al.,[15] mean baseline score for MDI was 5, and written and verbal information improved the pMDI technique at 16 weeks (score 7). The physical demonstration resulted in remarkable improvement at weeks 4, 8, and 16 (scores 7, 7, and 7). Our study showed a score of 7.02 after 6 months of education, and the results were comparable with the studies conducted by Bosnic et al. and Basheti et al. In our study, we did not find any association between inhaler technique and the types of inhalers preferred by the patients. There was no specific choice of a particular type of inhaler, and they adhered to devices advised by their treating physicians. However, some patients preferred MDI over DPI, s in a study conducted by Schreiber et al.[12] The probable reason to use MDI over DPI may be the ease of carrying a single device and the less time taken in an MDI without a spacer.

A study done by Rodrigues[16] showed improvement in technique prior to and after educational intervention in patients using MDIs from 15.4 to 46.2% after 3 months, and our study showed improvement at 1 month and 6 months posteducation, and it was 63.1% at baseline to 74.2% at 1 month and to 78% after 6 months. A study done by Rodrigues et al. was in cases of uncontrolled asthma, and no COPD patients were enrolled, which committed more critical errors in taking inhalation therapy.

In a study done by Basheti et al.,[14] mean scores for Diskus were 4.40 ± 2.60 vs 8.85 ± 0.41 and Turbohaler score, 4.96 ± 2.05 vs 8.63 ± 0.67, the results of which can be comparable with our study as both types of devices showed an increase in mean scores implying an improvement in inhalation technique after education. A study done by Rodrigues et al.[16] showed improvement in technique prior to and after educational intervention in patients using DPIs from 21.3 to 76.6% after 3 months, and our study showed improvement from 61.4% at baseline to 79% at 1 month and to 80.2% after 6 months and this study was done only in patients with uncontrolled asthma, and age of patients was <14 years whereas our study was done in both COPD and bronchial asthma patients of age >18 years.

A study which was conducted by Pothirat et al.[13] in COPD patients who used pMDI with spacers showed a decrease in the percentage of incorrect techniques from 70 to 60% after 1 month of education, which is comparable with our study. A study done by Dutt et al.[17] found that the technique improved from 9 (34.61%) to 14 (53.84%) after 1 month of technical training in patients using pMDI with spacers, and our study showed improvement from 69% at baseline to 82% after 1 month which is almost similar to improvement seen in the above study. Figure 4 depicts the inhalation steps failed by patients using various inhalation devices.

In various European studies, the results revealed that 50–60% of cases of COPD and asthma have poor control of the disease. The probable reason for the imperfect level of control is due to faulty inhalation techniques leading to poor adherence to the prescribed inhalers and other treatments.[18]

In the last 1 decade, the cases of respiratory diseases have been on the rise in India. The two leading diseases causing this surge are COPD and asthma. Nearly 63 million people nationwide suffer from COPD, which is nearly 32% of the global burden of COPD.[19] To the best of our knowledge, based on an available literature search, no study has been done in India to evaluate the impact of education in improving inhalation techniques in patients with COPD and bronchial asthma.

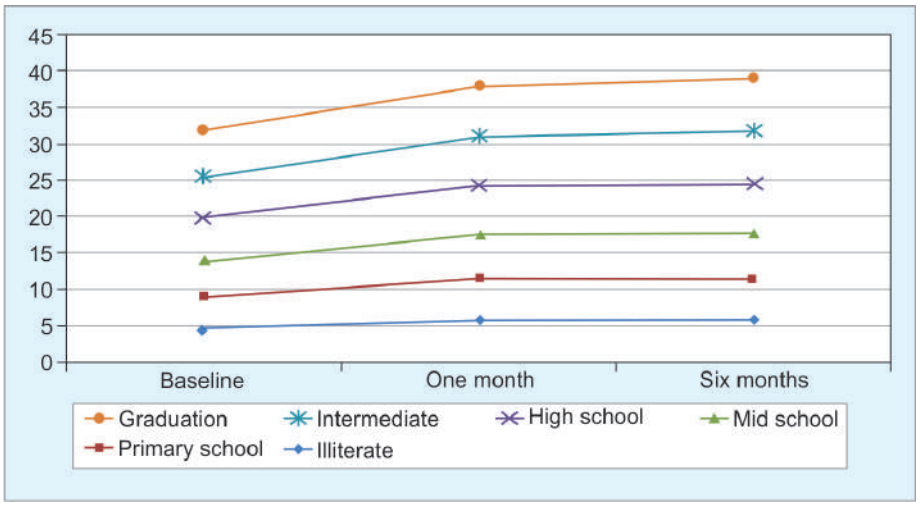

Fig. 3: Mean inhalation technique scored vs level of education

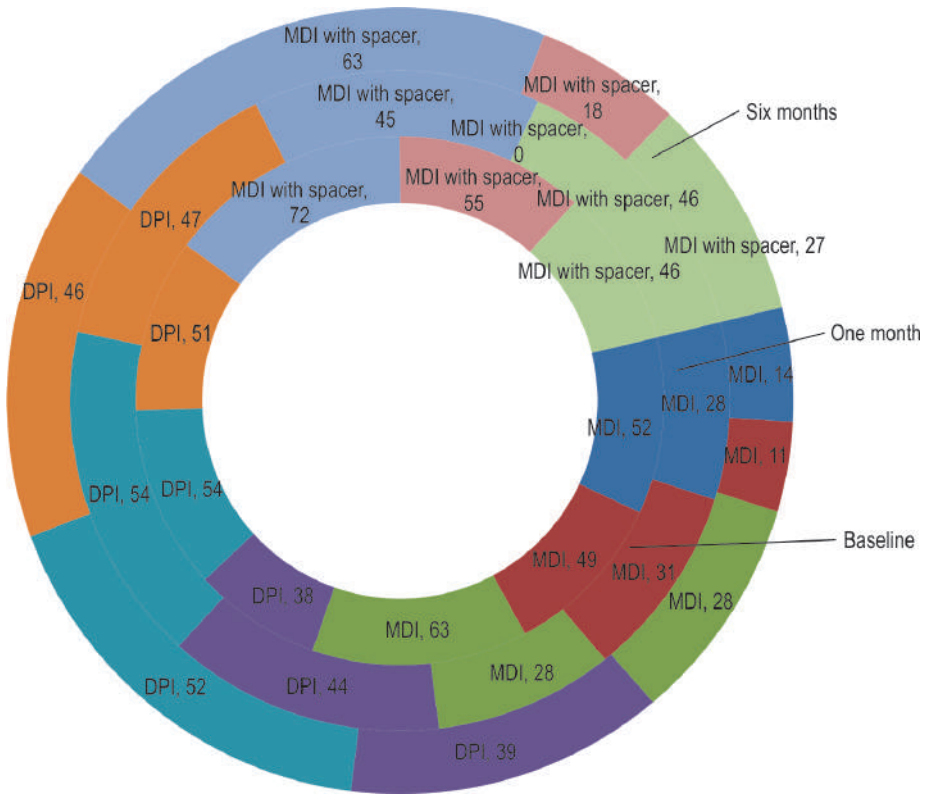

Fig. 4: Inhalation steps failed by patients using various devices

Education of patients is the prime factor that leads to the proper use of inhalation devices and the effectiveness of inhaled therapy. Inhalation therapy is the cornerstone of any chronic respiratory disease.[4] Awareness about the correct use of inhaler therapy may not only significantly improve the level of disease control but also allow dose tapering in the long run. This reduces the overall prescription cost as well. Our study was a prospective and observational study to analyze both the short and long-term effects of education on inhalation device use and handling.

This study is not without limitations. All patients using inhalers were included in the study ignoring the frequency and knowing their compliance to inhalation therapy. There was heterogeneity in the number of patients using each device. There was no control group in the study. Patients >60 years were not included. Lung functions were not done to see what was the impact of education on using inhalation devices. We did not assess the participant's cognition, which has an influence on the inhaler technique.

Conclusion

Patients using any inhalational devices can commit errors irrespective of age, sex, educational level, and residence. Every patient should be instructed, reinstructed, and evaluated for the use of inhalation devices, but more importance is to be given to uncontrolled asthma, the elderly, and patients with low educational status. Periodic directions and between checkups of inhalation steps should be executed. Unceasing education of health care providers, treating doctors, paramedical staff, and pharmacists about the right inhalation technique should be ensured in hospitals and outpatient clinics.

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