Research Article

The Impact of Patient Education in the Technique of Using Inhalers Among Asthma and COPD Patients in a Tertiary Care Hospital in Kerala

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ABSTRACT

Background: Bronchial asthma and COPD are common respiratory diseases characterized by airflow limitation, mucus hypersecretion, and inflammation, often presenting with cough and wheeze. This study aimed to evaluate the impact of patient education on the correct use of five commonly used inhaler devices.

Methods: A prospective interventional study was conducted over 6 months in a tertiary care hospital in Kannur. A total of 155 patients with asthma or COPD were assessed for their inhaler technique. Following initial evaluation, patients received education through demonstration using placebo inhalers and informational leaflets. Pre- and post-education scores were recorded using checklists adapted from the Dutch Asthma Foundation and manufacturers. The study included five inhaler devices commonly used in clinical practice: Revolizer, Rotahaler, Lupihaler, pressurized metered-dose inhaler (pMDI), and pMDI with spacer. Statistical significance was analyzed using the related-samples McNemar test, with $p < 0.05$ considered significant.

Results: Among participants, 37% used revolizers, 29% pMDIs, 15% rotahalers, 12% pMDIs with spacers, and 7% lupihalers. Only 52 patients (33.5%) performed all inhaler steps correctly, while 103 (66.5%) made at least one error. The most commonly prescribed medication was salmeterol with fluticasone propionate (23.2%). Errors in inhaler technique were prevalent across all device types.

Conclusion: Post-education assessment showed significant improvement in inhaler technique. The study highlights that patient education, including training and practical demonstration, plays a crucial role in improving inhaler use, leading to better disease control and enhanced quality of life.

Keywords: Bronchial Asthma; COPD; Inhaler Technique; Patient Education; Quality of Life

1. INTRODUCTION

Bronchial Asthma and COPD are the commonest respiratory diseases characterized by various degrees of airflow limitation, mucus and inflammation with patients often having symptoms of coughing and wheezing. Major therapeutic guidelines for Bronchial Asthma and COPD, including the GINA and GOLD guidelines, recommend inhalational medications as the first-line treatment for these obstructive pulmonary diseases [1, 2]. However, patient compliance to inhaled drugs is generally poorer than the compliance to oral medications and is known to be one of the causes of therapeutic failure. Inhalational treatment ensures rapid and direct delivery of the drug to the site of pathology and can be provided to patients through a range of devices including nebulizers, pressurized MDI and DPIs. In recent years, types of inhalers have increased which has expanded treatment options, but at the same time resulted in more complicated treatments for patients with the increased diversity of inhalational devices [3]. Despite

many teaching and training programs, poor inhaler technique remains common and has not improved over the years. This is commonly seen in patients with poor socio-economic status and in illiterate patients. Moreover, with an increasing number of patients, individualized counselling is a challenge to the limited number of physicians. Counselling the patients is known to increase the patient's knowledge regarding the disease, medications and lifestyle modifications, thus resulting in better therapeutic outcomes and quality of life. Direct patient education by pharmacists has been shown to be more effective in various studies than other teaching methods, including watching videos and providing inhaler pamphlets. Pharmacists can adopt several strategies such as the use of placebo inhalers, audio-visual aids and distribution of patient information leaflets so as to improve the quality of counselling [4-10]. Since the correct inhaler technique is crucial in delivering positive outcomes, the most logical approach would be to assess the role of pharmacists in patient education to improve the inhaler technique among the patients.

2. MATERIALS AND METHODS

Study design

A single-arm prospective pre–post interventional study was conducted among patients with bronchial asthma and chronic obstructive pulmonary disease (COPD) attending the Department of Pulmonology at a tertiary care hospital in Kannur, Kerala.The study duration was restricted to six months because this period was considered adequate to recruit eligible patients attending the pulmonology outpatient and inpatient departments and to complete baseline assessment, patient education, and follow-up evaluation within the available study timeframe.Each participant served as his/her own control, and inhaler technique before and after patient education was compared.

A randomized control group was not included because withholding inhaler education from patients with asthma and COPD, where incorrect technique may compromise treatment effectiveness, was considered ethically challenging.

The study was approved by the Institutional Human Ethical committee of Crescent College of Pharmaceutical Sciences filed under 006/2019/CCOPS/IEC.

Study Criteria

Inclusion criteria include the following: Patients of either sex with an age of above 18 and below 70 years with either Bronchial Asthma or COPD, who reviewed within 1-2 month/ patients who stay back at the hospital for a minimum of 3 days, using any among: Lupihaler, Rotahaler, pMDI, pMDI with spacer, Revolizer.

Exclusion criteria include the following: Patients of age below 18 and above 70 years, lactating and pregnant women. Patients with Alzheimer's disease or Dementia and those who are not able to explain the technique of the device. Patients who don't require review or who don't stay back at the hospital for a minimum of 3 days. Those who are not self-administering their inhaler therapy.

Study population: Patients diagnosed with Bronchial Asthma or COPD who visited the In-Patient and Out-Patient Department of the study setting.

Study material: Patient Data Collection Form, Inhaler specific checklists, Inhaler Leaflets and Placebo Inhaler.

Sample size: $n = 4pq/d^2$

Here, p is the expected prevalence (86%), q is 100 minus the prevalence (14%), and d^2 is the square of the margin of error, which is 25 in this case. Calculating with these values gives a sample size of 193 [11].

Although the calculated sample size was 193, 155 participants were included in the final analysis as only these patients fulfilled the eligibility criteria and completed both baseline and post-intervention assessments. The reduced sample size may have affected the statistical power for subgroup analyses; however, the observed improvement in inhaler technique demonstrated statistical significance. A post-hoc power analysis was performed based on the observed improvement in inhaler technique scores after intervention. Despite achieving a smaller sample size than initially calculated, the study demonstrated statistically significant improvement following education. However, the

reduced sample size may limit the precision of subgroup analyses among individual inhaler devices.

Consecutive sampling was taken due to unavailability of cases. Instead of using random or systematic sampling methods, all available eligible cases during the study period were included until the sample size goal was met.

Study procedure: A patient data collection form along with a checklist as well as Leaflets were designed for Lupihaler, Rotahaler, pMDI/pMDI with spacer and Revolizer for data collection and patient education. Detailed history was taken, including age of respondents, gender, height, weight, family history, social history like smoking and alcoholism and also any previous drug, dust or food allergy. Disease, type of inhaler, inhaled medication and the duration of inhaler use were also documented.

The patient was assessed on how well he/ she understands the technique of inhaler use. The steps done by the patient were recorded in the checklist which was adopted from the Dutch Asthma Foundation and manufacturers. The patient was then taught with the proper technique of using inhalers both verbally and with the help of leaflets as well as placebo inhalers. Patient follow-up was done after a period of 1-2 months for assessing the technique of using inhalers post-intervention, which was also documented using Checklists.

Post-education assessment was performed after 1–2 months using the same inhaler-specific checklist. The assessment included device preparation, loading of medication/capsule (where applicable), correct positioning of the device, exhalation before inhalation, inhalation technique, breath holding duration, device handling, and mouth rinsing after corticosteroid inhaler use.

Statistical analysis: The collected data was entered into a spreadsheet format using Microsoft Office Excel. Data was processed using statistical software IBM SPSS Statistics 23 version. Statistics of the paired nominal data were performed using the non-parametric test: related samples, McNemar Test, for which *p* value < 0.05 considered to be statistically significant.

3. RESULTS & DISCUSSION

Around 52.2% of the sample were patients with BA and the rest 47.8% were patients with COPD. In the present study, Bronchial Asthma was higher in the age group ranging from 21 to 30 whereas COPD was higher in the age group 61 to 70 years. It was found that around 42.6% of the study population was having a BMI greater than 24.5 which indicates unhealthy weight of the patients, among which 74.2% were overweight and 25.7% were obese. Among the study population, around 98 (63.2%) patients had a family history of either BA or COPD compared to the remaining 57 (36.8%) patients who didn't have any.

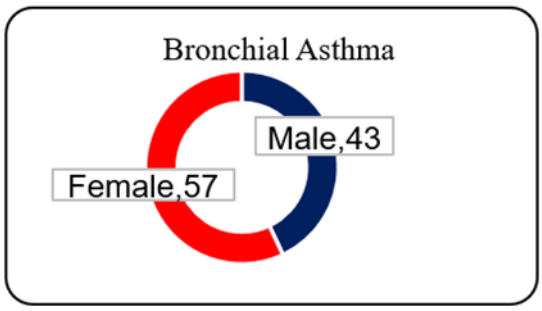

Figure 1: Gender-wise distribution of BA Patients

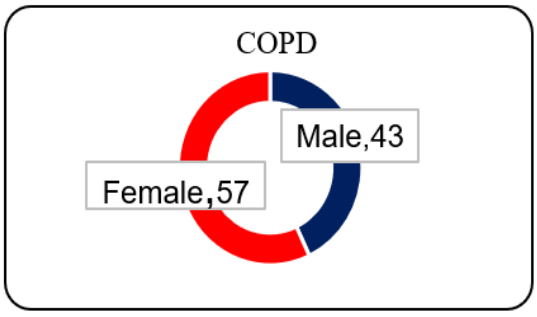

Figure 2: Gender-wise-distribution of COPD Patients

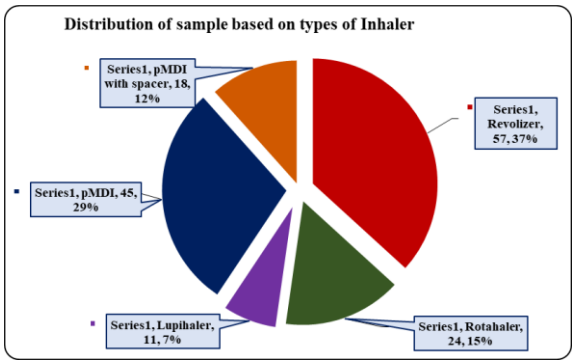

Figure 3: Distribution of sample based on types of Inhalers

Among 81 asthmatics enrolled in this study, 28 used revolizer, 14 used rotahaler, 4 used

lupihaler, 29 used pMDI and the rest 6 used pMDI with spacer. In the 74 COPD patients, 29 used revolizer, 10 used rotahaler, 7 used lupihaler, 16 used pMDI and the rest 12 used pMDI with spacer (Figure 3)

Pattern of prescription of inhalational medication

The complete medications used for both BA and COPD patients enrolled in the study belongs to four classes of medication namely; short acting beta2 agonist (SABA), long-acting beta2 agonist (LABA), long-acting muscarinic antagonist (LAMA) and inhaled corticosteroids (ICS) (Table 1). Out of 155 patients, Salmeterol and Fluticasone propionate was the most prescribed medication for around 36 patients (23.2%). COPD patients were commonly prescribed formoterol fumarate with a combination of fluticasone propionate or Budesonide whereas asthmatic patients were found to be commonly using salmeterol and fluticasone propionate. The distribution of the sample based on the inhaled medication is depicted in figure 4.

Table 1: Characteristics of the Prescribed Inhalational Therapy

INHALED MEDICATION	N (%)		
	ALL	**BA**	**COPD**
SABA	12	11	1
LAMA	31	13	18
LABA/ICS	92	48	44
LAMA/LABA	12	6	6
LAMA/LABA/ICS	8	3	5

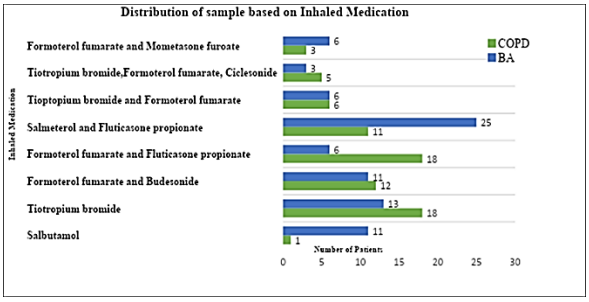

Figure 4: Distribution of sample based on Inhaled Medication

Table 2: Effect of patient education on inhaler technique among different inhaler devices

Inhaler device	**Number of patients (n)**	**Number of assessment steps**	**Mean inhaler technique score before education (%)**	**Mean inhaler technique score after education (%)**	**Mean improvement (%)**
Revolizer	57	10	74.74	93.16	18.42
Rotahaler	24	11	78.41	93.18	14.77
Lupihaler	11	12	76.52	93.94	17.42
pMDI	45	12	80.19	93.70	13.52
pMDI with spacer	18	14	76.98	93.65	16.67

Patient education resulted in improvement in inhaler technique scores across all five inhaler devices. The mean technique score improved from baseline values ranging between 74.74% and 80.19% to post-education values ranging between 93.16% and 93.94%.

4. DISCUSSION

In this study, an attempt was made to assess Patient education in technique of using of inhalers among Bronchial Asthma and COPD patients. Notably, only 52 (33.5%) patients could perform all the steps correctly in the use of inhalers, while 103 (67.7%) patients were unable to use their inhalers properly.

In this study 54% were male and 46% were female [Fig.1 and 2] where, male was predominant in having COPD and female predominant for development of BA which was found similar to a study conducted by Ocakli *et al*., [12]. A conflict to this was noted in a study by Bhandari *et al* where COPD was found in higher proportion in female due to extensive use of biomass fuel by rural women [13]. In the present study, BA was more prevalent in the age below 40 years and COPD most prevalent in the age group above 40 years. A similar prevalence was reported in a study conducted by Bhandari *et al*, in which age group above 60 were most affected with COPD. Also, among the several studies conducted suggests that patients in the age group of 40-66 years comprised more than half of the entire COPD population worldwide.

In this study 57% of the asthmatics enrolled were female and 49.4% of the asthmatic patients were having higher BMI being either overweight or obese which is in accordance with the study of Wang et.al that stated the prevalence of asthma was higher in female than male as well as BMI was positively associated with Bronchial

Asthma. Another study conducted by Altintop *et al* stated that obesity was associated with poor asthma-specific quality of life.[14] The present study showed that 48.4% were non- smokers, 27.1% smokers, 11% were alcoholic and 13.5% both, of which 50% of the COPD patients had a history of smoking which is similar to the study of Sangita *et al.,* where 36% were smokers and 48% were ex-smokers [15]. Around 77.8% of Asthmatics had a history of some previous allergies of which 14.8% had allergy to dust, where dust being a common trigger to Asthma, 40.8% were allergic to certain foods and the rest 22.2% with both dust and food allergies. Food allergy and asthma are characterized by an increasing prevalence and were found to be coexisting in patients enrolled in the present study. Even though both conditions are associated with each other in different ways, food allergy is a risk factor of developing asthma, where ingestion or inhalation of certain allergic foods leads to respiratory reactions, cough and wheezing [16]. 70.4% of Asthmatics enrolled in the study had a positive family history of asthma in one or more first-degree relatives which is consistently identified as a risk factor for asthma as of stated in the study of Burke *et al*., [17].

All of the 155 patients were categorized based on the duration of inhaler use as less than 5 years, 5 to 10 years and more than 10 years. It was found that patients with experience of using inhalers above 10 years were less likely found to perform the inhalational technique incorrectly except rinsing of mouth and a few reported oral thrushes to be frequently there. Patients using inhalers for about less than 10 years made comparatively more errors in the techniques of inhaler use as of in accordance to the study of Ocakli *et al.,* which stated shorter durations of handling the devices was more prone to errors [12]. The results from the study revealed that only 33.5% of the patients enrolled performed all the steps correctly whereas 66.5% of the patients did at least one error. A similar result was reported in a study by Khurana *et al., [18]*. Among various devices been used, only 33.3% (N=19) of patients using revolizer, 33.3% (N=8) of patients using rotahaler, 45.4% (N=5) of patients using lupihaler, 31.3% (N=14) of patients using pMDI and 33.3% (N=6) of patients using pMDI with spacer would correctly complete all steps of usage of their inhalational devices. Majority of the patients who incorrectly used inhalers was found to be correcting the techniques after proper education given with the aid of leaflets and demonstration using placebo inhalers similar to the studies of Ansari *et al,* Aastha *et al* and Hemalatha *et al.,* [19-21].

In the present study, the most prescribed class of drug in both the diseases was LABA and ICS combination, Salmeterol and Fluticasone propionate for around 36 patients followed by LAMA, SABA, combination of LAMA/LABA and LAMA/LABA/ICS. In addition to the same LABA/ICS combination and SABA mentioned in this study, Anticholinergics was another class most commonly prescribed for COPD stated in the study of Sangita *et al*., [15].

In this study as indicated in table 2, 59.3% were using DPI and the rest 40.7% were on pMDI. The DPI device most commonly used was the revolizer (37%) followed by the rotahaler (15%) and the lupihaler (7%). Around 29% were using pMDI and the rest 12% were on pMDI with spacers. Regarding inhalation technique, the most common errors made while using DPI inhaler in our study was, and most patients failed to correctly perform the steps “exhale to residual volume”, “inhale forcefully and deeply” as well as “hold breath for five seconds”. A number of patients also failed to “insert the capsule with the transparent end down”. Various other studies also showed the patient failure in aptly performing various steps involved in inhaler use. In the present study, common error patients made while using pMDI and pMDI with spacers was least patients performed the steps, “hold inhaler upright and shake well”, “hold spacer level and press down firmly on canister once” correctly. Similar errors were reported in a study of Makhinova *et al*., [22]. Yet there was significant improvement in these steps post intervention which was in accordance to the study by Usmani OS *et al*., [23]. Irrespective of the inhaler used, most of the patients (66.4%) failed to rinse mouth after inhaler use. Failure in rinsing mouth after using an inhaled corticosteroid often resulted in

developing the ADR, Oral candidiasis which most of the patients reported during the study.

A study by Fukushima *et al.,* stated that the amount of isolated Candida was significantly greater in asthmatic patients treated with fluticasone than in those treated with beclomethasone and the dosage should be taken care as the amount of Candida increased with dose of fluticasone [24]. There are some limitations in the study. All patients using inhalers were recruited irrespective of the frequency and regularity of their usage, Patients were aware that their inhalation technique was being evaluated, which consequently introduced bias. The present study could not follow- up in the areas of ADR using Inhalers.

Future studies should incorporate validated disease-specific outcome measures such as Asthma Control Test (ACT), COPD Assessment Test (CAT), exacerbation rates, and pulmonary function testing to determine the clinical impact of inhaler education

Although the present study demonstrated significant improvement in inhaler technique following patient education, clinical outcomes such as asthma control scores, COPD assessment scores, exacerbation frequency, hospitalisation rates, and pulmonary function parameters including FEV1 were not evaluated. Therefore, improvement in inhaler technique cannot be directly interpreted as improvement in clinical outcomes. Future studies incorporating validated clinical outcome measures and longer follow-up periods are required to determine the impact of inhaler education on disease control and quality of life.

Although improved inhaler technique is an important intermediate outcome, this study did not establish whether the intervention resulted in measurable improvement in disease control, lung function, reduction in exacerbations, or quality of life. Future studies incorporating ACT, CAT, FEV1 measurements and longer follow-up are required.

4. CONCLUSION

Patient education significantly improved inhaler technique among asthma and COPD patients. The findings of the present study revealed that there is a high prevalence of errors in inhaler technique in terms of inhaler handling and critical steps which were similar and common in both Bronchial Asthma and COPD irrespective of the devices used. Patient education was done by assessing the patient's knowledge on the proper inhaler techniques, scoring in specific checklists, then counselling and providing demonstrations using leaflets and placebo inhalers. Post- education assessment of the patients showed great improvement and demonstration of the proper technique reduced the errors committed during inhaler use. Therefore, it is important that the health-care professionals should insist on bringing up educational programs to be set up in the community aiming at improving the inhalational technique of patients using different inhaler devices, to further curtail the morbidity and mortality of patients. Hence, providing proper instructions and education regarding inhaler use can improve inhaler technique, leading to improved inhaler technique, which may contribute to better disease control and potentially improved quality of life. However, quality of life was not directly assessed in this study.

LIMITATIONS

1. A longer follow-up period would be required to assess sustained improvement in inhaler technique, disease control, pulmonary function, and long-term quality of life outcomes.

2. The smaller-than-calculated sample size may have reduced the power of the study, particularly for device-specific comparisons. Future multicentre studies with larger sample sizes are required to confirm these findings.

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CONFLICT OF INTEREST

Authors declare that no conflict of interests exist.

FUNDING INFORMATION

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ETHICAL INFORMATION

Ethical approval was obtained from the Institutional Human Ethical Committee of Crescent College of Pharmaceutical Sciences (Approval No: 006/2019/CCOPS/IEC). Written informed consent was obtained from all participants before enrolment.

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