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Evaluation of asthma control after reinforcement of proper inhaler techniques in a tertiary care center in northern India

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Abstract

Asthma is an obstructive lung disease with high prevalence. Symptom control in asthma remains poor despite significant advancements in treatment guidelines and inhalational devices. This is often attributed to inadequate patient adherence to the inhaler technique and insufficient education on its long-term use. Through this study, we aimed to assess the impact of reinforcement of proper inhaler technique on asthma symptom control and quality of life. A prospective cohort of 400 asthma patients using dry powder inhalers and metered dose inhalers was recruited in the outpatient clinic of our hospital. At the time of recruitment, the correctness of inhaler technique usage was assessed, and the pre-test Inhaler Technique Score (ITS) was recorded for each patient. Then, a ten-step inhalation technique was taught through demonstration, and the post-test ITS score was recorded again. This was done for each patient at monthly intervals for 3 months. Along with it, two tailored questionnaires, the Asthma Control Test (ACT) and Asthma Quality of Life Questionnaire (AQLQ), were administered at each visit to assess disease control and quality of life. Significant enhancements in inhalation technique were noted from the first to the third visit using the ten-step inhalation usage scores, which improved from 6.91 to 9.87 (out of 10) ($p<0.001$), paralleled by ACT score increases from 17.06 to 19.37 (out of 25) ($p<0.001$) from visits one to two, and from 19.37 to 20.52 (out of 25) ($p<0.001$) from visits two to three, signifying improvement in symptom control. Quality of life similarly improved from 4.45 to 5.12 to 5.45 (out of 7) ($p<0.001$) across the three visits as assessed by AQLQ. In conclusion, promoting proper inhaler technique through structured education programs is crucial for optimizing long-term asthma management and enhancing patients' quality of life.

Key words: inhaler technique, metered dose inhaler, dry powder inhaler, adherence, quality-of-life, patient education

Introduction

Inhalational medications are the mainstay in contemporary asthma treatment due to their ability to deliver therapeutic doses directly to the lungs while minimizing systemic side effects [1]. Effective inhaler use is critical for achieving optimal symptom control and disease management. However, ineffective techniques can compromise drug delivery, leading to decreased efficacy and poor outcomes in asthma management. Patient adherence to prescribed inhalation therapies significantly influences treatment effectiveness [2-4]. Studies have highlighted that a substantial proportion of patients, over 60% in some reports, do not use their inhalers correctly, thereby reducing the medication's efficacy [5,6]. This underscores the importance of patients' knowledge of inhaler technique as well as the ability of healthcare providers to instruct on proper technique on the treatment outcomes [7,8].

While inhaler devices vary in dose preparation and operational mechanics, fundamental principles of correct inhalation technique apply universally. Hence, personalized patient education, assessment, and training are crucial components of effective asthma care [9,10]. Guidelines universally recommend that patients should not start using a new inhaler device without adequate training from a healthcare professional and demonstration of correct technique [11].

Despite the clear guidelines advocating for proper inhaler technique training, there remains a scarcity of qualitative data assessing asthma control following reinforcement of correct inhaler technique. Thus, this study was carried out to assess patient compliance with the correct inhaler technique and the effect of training interventions on the same, thereby serving as a guide to improved clinical practice and patient management strategies.

Materials and Methods

Study population

The study was conducted in the Department of Pharmacology and the Department of Pulmonology in a tertiary care centre in Northern India. It included 400 asthma patients observed over monthly visits for 3 months. The sample size was determined based on Singh S. et al. [12]. Inclusion criteria were: age >18 years and use of inhaler therapy for at least 3 months. Exclusion criteria included: participation in other clinical trials; terminal illness; and initiation of new asthma therapy during the study.

Study design

The study was a prospective cohort study conducted for a duration of 12 months from August 2022 to August 2023. The objective was to assess the compliance of patients to proper inhaler technique through an inhaler technique score (ITS) which ranged from 0 to 10 (*Supplementary*

Table 1) with a score of 0 indicating no compliance to 10 indicating full compliance. Then, the reinforcement of the proper inhaler technique was done via a 10-step technique demonstration, and its effect on the ITS score was evaluated. Further evaluation was done to analyse the effect of the correct inhaler technique on asthma control using the Asthma Control Test (ACT). The ACT scores range from 5 (poor control) to 25 (complete control), with scores >19 indicating well-controlled asthma. The change in quality-of-life post-reinforcement with the Asthma Quality of Life Questionnaire (AQLQ) was also observed. AQLQ is rated on a 7-point Likert scale, where 1 denotes maximal impairment and 7 denotes no impairment in quality of life. The study procedure is summarized as follows:

1. **Baseline:** Participants completed a pretest on inhaler technique knowledge (ITS), ACT, and AQLQ. Following a demonstration of inhaler technique steps, a post-test ITS score was obtained.
2. **Week 4:** Participants were reassessed using ACT and AQLQ. A second ITS demonstration was given as reinforcement, with ITS scores recorded before the demonstration.
3. **Week 8:** Final assessment was conducted using ITS, ACT, and AQLQ.

Results

Out of the 400 patients, there was no drop-out and the data of all patients were recorded and analysed. The average values of demographic parameters and anthropometric details of the study participants (n=400) are shown in Table 1.

The mean ITS Pre-test scores (out of 10) of all patients at baseline, week 4 and week 8 were 6.9 ± 1.7, 9.55 ± 1.017 and 9.87 ± 0.719 respectively. A paired t-test was done to compare ITS score values between baseline and week 4 and further between week 4 and week 8. There was a significant increase in ITS score from baseline to week 4 (p-value < 0.05). Similarly, there was a significant increase in ITS score from week 4 to week 8 (p-value < 0.05). The mean post-test ITS score at each monthly visit for all patients came out to be 10.

The ACT scores were also recorded for each patient at baseline, week 4, and week 8. The mean ACT score (out of 25) for all patients came out to be 17.1 ± 3.3, 19.4 ± 2.7, and 20.5 ± 2.3 at baseline, week 4, and week 8 respectively. On paired t-tests, there was a significant (p-value < 0.05) increase in ACT values from baseline to week 4 and further from week 4 to week 8.

The AQLQ scores were also recorded for each patient at baseline, week 4, and week 8. The mean AQLQ score (out of 7) for all patients came out to be 4.45 ± 1.03, 5.12 ± 0.85, and 5.45 ± 0.73 at baseline, week 4, and week 8 respectively. On paired t-tests, there was a significant

(p-value < 0.05) increase in AQLQ values from baseline to week 4 and further from week 4 to week 8.

A Pearson correlation analysis was performed to evaluate the role of the ITS score in influencing the ACT score and AQLQ score. There was a positive significant correlation (r^2 = 0.659; $p < 0.05$) between the change in ITS scores from baseline to week 4 and the change in ACT scores from baseline to week 4. Similarly, there was a positive significant correlation (r^2 = 0.539; $p < 0.05$) between the change in ITS scores from week 4 to week 8 and the change in ACT scores from week 4 to week 8. Likewise, there was a positive significant correlation (r^2 = 0.583; $p < 0.05$) between the change in ITS scores from baseline to week 4 and the change in AQLQ scores from baseline to week 4. Also, there was a positive significant correlation (r^2 = 0.404; $p < 0.05$) between the change in ITS scores from week 4 to week 8 and the change in AQLQ scores from week 4 to week 8.

Discussion

The Pre-test ITS score at baseline was conducted amongst the participants who were already on Inhalers for a minimum duration of the past 3 months. The results had a mean score of 6.91 ± 1.71 with a maximum score being 10 and the minimum score being 4. This emphasizes the very basis of this study that despite timely diagnosis and proper medication, patients are not following the correct inhaler technique. Our findings are consistent with an earlier study by Lia Jehedi et al that found that even though most asthmatic patients were confident in their technique, many did not use their inhaler(s) correctly [13]. The Pre-test ITS score at week 4 had a mean value of 9.55 ± 1.01 with significant improvement ($p <0.05$) from baseline values. This indicates if the participants are taught the inhaler technique along with a proper demonstration of each step in the correct sequence, their compliance to the inhaler technique improves. Further, the Pre-test ITS score at week 8 had a mean value of 9.87 ± 0.71 with significant improvement over ITS score values at week 4. This shows that the reinforcement of the Inhaler technique can be an essential intervention for the continued success of the treatment over time. These results demonstrate how crucial is the role of proper inhaler technique in the management of asthma [13]. The Post-test ITS scores demonstrating short-term learning of the patient on all three occasions were found to be 10 in all 400 participants. This was because it was made sure that every patient should learn the inhaler technique correctly before leaving the outpatient department and to ensure that patients would follow the steps accordingly while taking the medication.

The ACT was done to assess the level of symptom control of Asthma in the patient at Baseline, Week 4 and Week 8. The mean value of ACT at baseline was 17.06 ± 3.27 which means that asthma was not well controlled. This significantly ($p < 0.05$) improved to ACT scores being

19.37 ± 2.67 and 20.52 ± 2.31 at week 4 and week 8 respectively indicating a transition to well-controlled asthma. On Pearson's correlation, we found out that the change in Pre-test ITS score from one visit to the subsequent visit significantly correlated with the corresponding change in ACT scores. This highlights the impact of adherence to the correct inhaler technique on symptom control in asthma. In previous studies, it has been similarly found that the adherence of patients to medications improved disease control and decreased the risk of exacerbations as well [14-16].

Asthma can be a crippling disorder that negatively impacts a person's quality of life. In this study, the AQLQ score was calculated for each patient at baseline, Week 4 and Week 8 to assess their quality of life. The mean value of AQLQ at baseline was 4.45 ± 1.03 which means that there was moderate limitation which significantly improved to 5.12 ± 0.85 and 5.45 ± 0.73 at week 4 and week 8 respectively. On Pearson's correlation, the change in AQLQ values from baseline to Week 4 correlated significantly with the corresponding change in Pre-test ITS scores and ACT scores from baseline to week 4. Similarly, the change in AQLQ values from week 4 to Week 8 also correlated significantly with the corresponding change in Pre-test ITS scores and ACT scores from week 4 to week 8 [17]. This becomes significant for asthma patients because they must keep taking medication for longer durations and the quality of life is an apt measure to evaluate the overall treatment effectiveness.

Conclusions

The reinforcement of proper inhaler technique results in better Asthma control and better quality of life in patients with bronchial asthma. This places the healthcare provider in a crucial position to oversee inhaler technique and interact with the patient to enhance adherence. Also, simple tools like demonstration of inhaler technique steps and checklists can have a major impact on adherence thus leading to better treatment outcomes.

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Online supplementary material:
Supplementary Table 1. Inhalation technique steps (ITS) and score.

Table 1. Demographic and clinical parameters of all patients at baseline, 4 weeks and 8 weeks.

	Baseline	**4 weeks**	**8 weeks**
Age (Median)	38 years		
Gender (Male)	43.8%		
Weight (kgs)	63.4±13.3		
Height (m)	1.6±0.08		
BMI (kg/m^2)	24.4±4.7		
Pretest ITS score[a] (mean±SD)	6.91±1.71	9.55±1.01*	9.87±0.71**
Post-test ITS score[a] (mean±SD)	10	10	10
ACT score[b] (mean±SD)	17.06±3.27	19.37±2.67 *	20.52±2.31**
AQLQ score[c] (mean±SD)	4.45±1.03	5.12±0.85 *	5.45±0.73**

BMI, body mass index; ITS, inhaler technique score; SD, standard deviation; ACT, asthma control test; AQLQ, asthma quality of life questionnaire; [a]total score out of 10; [b]total score out of 25; [c]total score out of 7; *p<0.05 on paired *t*-test between scores of weeks 4 and day 0; **p<0.05 on paired *t*-test between scores of week 8 and week 4.