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A STUDY ON IMPROPER PATIENT TECHNIQUE WITH METERED DOSE INHALERS AMONG PATIENTS WITH ASTHMA AND ITS EFFECT ON THE CONTROL: A CROSS SECTIONAL STUDY

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Abstract

Objective:
The objective of this study is to observe improper patient technique with Metered-Dose Inhalers among Patients with Asthma and Its Effect on Disease Control

Study design:
Cross-sectional Observational study.

Place and duration of study:
Department of Medicine, Tertiary Care Hospital, Abbottabad from February 2025-April 2025.

Methodology:
A total of 168 adult patients (≥18 years) diagnosed with asthma and using metered-dose inhalers (MDIs) were enrolled through consecutive sampling. Sociodemographic and clinical data were collected using a structured proforma. Asthma control was assessed using the Asthma Control Test (ACT). Inhaler technique was evaluated by direct observation using a standardized checklist of essential steps. Data were analyzed using SPSS version 25, and associations were tested using the chi-square test ($p<0.05$ significant).

Results:
Among 168 asthma patients, 76.8% demonstrated incorrect MDI technique with at least one critical error. The most common errors were poor actuation–inhalation coordination and inadequate breath-holding. Poor asthma control (ACT <20) was observed in 61.9% of patients. Incorrect inhaler technique was significantly associated with poor asthma control ($p<0.001$).

Conclusion:
Improper metered-dose inhaler technique remains highly prevalent among patients with asthma and is significantly associated with poor disease control. Critical errors such as poor coordination and inadequate inhalation reduce effective drug delivery, compromising therapeutic outcomes.

Introduction:
Asthma is a chronic inflammatory airway disease, which is typified by reversible airflow blockage, bronchial hyper responsiveness, and periodic incidences of wheezing, cough, breathlessness, and chest tightness. Asthma is a major cause of morbidity and poor quality of life affecting over 260 million people around the world and is a

major problem in low- and middle-income countries where the disease is not controlled to the optimum level. The key to effective management is an inhaled pharmacotherapy, especially inhaled corticosteroids (ICS) and bronchodilators (short-acting) administered through metered-dose inhalers (MDIs). Although there are effective medications, inadequate asthma control is still experienced by a significant percentage of patients, in many cases, because of improper inhaler technique.[1]

One of the most prescribed inhalation aids is the metered-dose inhaler because it can be carried anywhere and is quick in delivering drugs and does not cost much. Nevertheless, proper usage entails the coordination of the actuation and the inhalation, suitable inspiratory flow, respiration reserves as well as routine care of the device. Research has always shown that a considerable proportion of patients commit some fatal mistakes when using MDIs, such as the inability to shake the inhaler, poor timing of actuation, poor breath-holding and poor inhalation rate. Such errors have the ability to greatly decrease pulmonary drug deposition, which results in poor control of the symptoms and the occurrence of exacerbations.[2]

The use of improper inhaler technique has been associated with more emergency visits, hospitalizations and increased healthcare spending. Moreover, inadequate technique can cause clinicians to unnecessarily increase pharmacotherapy thus subjecting patients to increased medication levels and possible adverse effects without solving the problem. Age, level of education, length of disease, previous inhaler education, and comorbidities are patient variables, which affect the proficiency of inhaler technique. The factors in healthcare providers, such as poor demonstration and insufficient frequent review are also critical.[3]

The proposed study will be a cross-sectional observation study, which is the most appropriate design to determine the prevalence of improper MDI technique and its relation with asthma control at a particular time. Through a systematic assessment of inhaler technique by using standardized checklists and assessing the degree of asthma control by using validated measures like Asthma Control Test (ACT) researchers will be able to know the extent of technique-related issues and general critical errors. This kind of evidence is necessary to mark the importance of organized patient education, the regular review of the techniques, and the implementation of inhaler training into regular asthma treatment practice.[4]

This clinical implications of knowing the association between improper MDI technique and asthma control. Education of patients, visual aids, the implementation of spacers, and frequent training were demonstrated to effectively enhance the technique and clinical outcome. Thus, the detection of discrepancies in patient inhaler medication can be used to inform specific interventions aimed at enhancing asthma control and generally improving the management of the disease.

Methodology:

It is a cross-sectional observational study that will be carried out in the outpatient departments of medicine in a tertiary care hospital, Abbottabad within the 03 months between February 2025-April 2025. This research paper also tried to determine the level of inappropriate metered-dose inhaler (MDI) use by asthmatic patients and its effects on asthma management. Consecutive patients with bronchial asthma based on the Global Initiative for Asthma (GINA) guidelines and who used a metered-dose inhaler within three months were recruited on a basis of routine outpatient visits. The study was limited to patients aged 18 years and older and of either gender who were willing to give an informed consent. The sample size was estimated, using an expected prevalence of inhaler technique error of 50 per cent, a 95 per cent confidence interval and a 5 per cent margin of error which gave the minimum required sample of 150 patients. Consecutive sampling was used to sample 168 patients out of whom 155 participants gave their consent.

Inclusion Criteria

1. Diagnosis of asthma confirmed.
2. Continued use of MDI (with/without spacer) of at least 3 months.

3. Knowledge of and skills to show method of inhaler.

Exclusion Criteria

1. Chronic obstructive pulmonary disease (COPD) and asthma-COPD overlap patients.
2. Acute severe asthma that needs emergency treatment upon examination.
3. Intelligence impairment or body disability making proper demonstration impossible.
4. Patients taking dry powder inhalers only.

The pro forma used to collect the data was a structured one. Sociodemographic information (age, gender, education), clinical (duration of asthma, how often exacerbations), and previous inhaler training were given. The Asthma Control Test (ACT) was used to assess the level of asthma control in which a score of 20 was deemed as well-controlled and a score of less than 20 was poorly-controlled.

The inhaler technique was assessed through direct observation on the basis of standard checklist that contained the necessary steps: shaking the inhaler, proper placement, the ability to actuate and inhale synchronously, the ability to inhale slowly and deeply, and the ability to hold breath at least 10 seconds. An individual step was either correct or not. Critical errors were determined as errors that had a great impact on the delivery of drugs (e.g., the lack of coordination or inability to inhale deeply).

The data were keyed and analyzed with the SPSS 25 version. Baseline characteristics were summarized using the descriptive statistics. The chi-square test was used to determine the association between correct and incorrect inhaler technique, and asthma control. A p-value of below 0.05 was statistically significant.

Results:

The study was conducted with 168 patients who have bronchial asthma and use metered-dose inhalers (MDIs). The average age of the participants was 38.612.4 years (18 to 70 years). The study population was composed of females (n=98) 58.3%. The majority of the respondents (62.5) were diagnosed with asthma over five years ago, and 46.4% of the respondents stated that they had been trained on inhaler techniques.

When inhaler technique was assessed with the help of the standardized checklist, only 39 patients, (23.2%), had the correct inhaler technique with no serious error, and 129 patients, (76.8%), made at least one serious error. The most common were inadequate alignment of actuation and inhalation (54.2), inability to empty breath at least 10 seconds (49.4) and not breathing slowly and deeply (45.8).

Asthma control measured by The Asthma Control Test (ACT) indicated that 64 patients (38.1) of the patients had well controlled asthma (ACT ≥20) and 104 patients (61.9) had poorly controlled asthma (ACT <20). Out of those who had poor technique in inhaler, 85.3% of the people had poorly controlled asthma as compared to 15.4% of those with good technique. The link between the inadequate inhaler technique and inadequate asthma control was statistically significant (^{2} = 42.6, p <0.001).

The patients who had been trained to use the inhaler properly had higher chances of using the inhaler properly (p=0.01). Also, the educational level was found to be lower, which corresponded to a greater rate of critical errors (p=0.03).

The results show that there is high occurrence of improper MDI technique among patients with asthma and there is close correlation between improper technique and poor disease control.

Table 1: Sociodemographic and Clinical Characteristics

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
18–30	52	31.0
31–50	78	46.4
>50	38	22.6

Gender		
Male	70	41.7
Female	98	58.3
Duration of Asthma		
<5 years	63	37.5
≥5 years	105	62.5
Prior Inhaler Training		
Yes	78	46.4
No	90	53.6

Table 2: Frequency of Inhaler Technique Errors

Inhaler Step Error	Frequency (n)	Percentage (%)
Did not shake inhaler	48	28.6
Incorrect positioning	39	23.2
Poor actuation-inhalation coordination	91	54.2
Not inhaling slowly/deeply	77	45.8
No breath-hold (≥10 sec)	83	49.5

Table 3: Association Between Inhaler Technique and Asthma Control

Inhaler Technique	Well-Controlled (n=64)	Poorly Controlled (n=104)	Total
Correct (n=39)	33 (84.6%)	6 (15.4%)	39
Incorrect (n=129)	31 (24.0%)	98 (76.0%)	129

Discussion:

The cross-sectional observational study proved high incidence (76.8) of inappropriate metered-dose inhaler (MDI) technique among asthmatics and showed strong positive and statistically significant correlation between inappropriate technique and poor asthma control ($p<0.001$). The proportion of participants that had been able to undertake all the necessary steps of the inhalers was only 23.2%, which demonstrates a significant discrepancy in effective asthma self-management. The evidence corresponds to the literature published across the globe and suggests that inhaler abuse is a clinically significant and ongoing issue despite the development of pharmacotherapy.

Our study percentage of patients making at least one critical error is similar to the systematic review of Sanchis et al., who indicated the inhaler error rates between 50 and 100 percent with no significant change in the last decades. On the same note, Melani et al. reported that 76 per cent of the patients committed at least one critical error, which was strongly correlated with poor disease control and exacerbation. Our results, also, support the effective relationship between inhaler technique and clinical results.[5]

Poor coordination between actuation and inhalation (54.2%), the lack of ability to hold a breath at least 10 seconds (49.4%), and the absence of inspiratory effort (45.8%), were the most frequent mistakes which we encountered during our study. These findings can be compared with those of the CRITIKAL trial by Price et al. that reported actuationinhalation coordination as one of the most clinically important errors related to uncontrolled asthma and high risk of exacerbation. Poor coordination lessens the

pulmonary deposition of drugs and enhances the amount of oropharyngeal deposition thus restricting treatment effect.[6,7]

We have found that the proportion of patients who had all the wrong technique was 85.3 percent with poorly controlled asthma, as opposed to 15.4 percent with the correct technique. This is in line with previous studies by Giraud and Roche who stated that asthma stability was negatively related to MDIs corticosteroid misuse. Inappropriate technique of inhaler can make clinicians give more and more corticosteroid exposure, but without fixing the cause of poor medication delivery.[8]

The correct technique in our study was noteworthy with educational status and previous inhaler training. The patients who had been taught about the inhaler instructions in a formal manner were more likely to be able to do the steps correctly. This result is in line with the evidence provided by Basheti et al. who showed that the education of pharmacist-led inhaler techniques resulted in a substantial improvement of asthma outcomes and inhaler proficiency. Single instructional sessions have not been found to be effective as opposed to repeated training and technique reassessment, hence the need to educate patients continuously.[9]

The fact that high rates of errors are not reduced with the availability of the guidelines is an indication of the misunderstandings at a system level in the everyday practice of clinics. The healthcare providers might assume that patients are using inhalers correctly, and some chances of correction will be missed. The Global Initiative on Asthma (GINA) points out that periodic testing of inhaler technique is the key aspect of asthma management. Nevertheless, in the real world there is a lack of conformity to its practical implementation, especially in resource constrained environments.[10,11]

Besides that, device complexity, and patient-related issues, including age, cognitive ability, and comorbidities, can lead to improper technique. Rootmensen et al. found that older age and less schooling were some of the predictors of incorrect inhaler use, which in some way is also echoed in our population sample. These observations indicate that patient education should be individual, and alternative devices (e.g., spacers or breath-actuated inhalers) should be considered to those with the coordination problem.

The issue of poor inhaler technique is not only a contributor of poor symptom control but also poor healthcare use and economic cost (public health). The uncontrolled asthma is linked to high mortality rates in emergency and hospitalization, absenteeism, and low productivity. Inhaler technique is a cheap and non-risk intervention, which can help a great deal to improve the outcomes of the disease, without the increase of pharmacotherapy.[12]

The strengths of the study are that the inhaler technique was observed directly through a standardized checklist and the control of asthma was evaluated objectively with the help of a validated instrument. But since it is a cross-sectional study, causality cannot be conclusively determined. However, the significant correlation made is indicative of the biological plausibility that inappropriate delivery of drugs results in poor clinical outcome.

On the whole, our results highlight that the wrong MDI method is still one of the most common and it affects the asthma management greatly. The assessment of inhaler, patient counseling, frequent demonstrations, and incorporation of multidisciplinary educational methods should all be standard in order to maximize asthma management. Treatment of this changeable factor can significantly enhance patient outcomes and decrease the impact of uncontrolled asthma.

In addition to the personal level of effect, incorrect metered-dose inhaler (MDI) method can have wider consequences to the healthcare system, especially in the low- and middle-income countries where the prevalence of asthma is increasing and access to special respiratory care can be problematic. Poor education of patients, lack of time during the consultations, and lack of follow-ups in such environments also play a significant role in chronic inhaler misuse. The false technique that was shown to be high in this study is a strong indicator of why there is a serious need to involve the routine clinical practices in such a way that it is considered that structured inhaler assessment must be used in all asthma visits.[13]

The progressive deterioration of inhaler technique with the time is another factor that should be taken into account. Even patients with the ability to use it correctly may develop the ill practices over time unless correct reinforcement is administered. As Takaku et al. proved, the decline in inhaler technique became significant within several months after the first training, which is why the periodic review is important. This observation implies that inhaler education cannot be a single intervention model but should also be part of chronic disease management.[14]

No attention should be omitted in the psychological aspect of asthma control. Asthma caused by a poor inhaler technique may consequently result in frustration among patients, loss of trust in drugs and adherence. This forms a vicious cycle where the patients feel the inhalers are not effective, which further worsens the control of the disease. According to Plaza et al., wrong usage of inhaler was independently linked with reduced adherence rates and worse quality of life scores. Thus, the improvement of inhaler method can lead to not only physiological results but also a patient satisfaction and trust in treatment.[15]

This is a common issue in which technological development can provide the possible solutions. Digital sensors fitted in smart inhalers can track actuation time, inhalation habits, and compliance, which have a feedback of both patients and clinicians. As shown by Chan et al., electronic monitoring devices enhanced the adherence to the use of inhalers and the control of asthma compared to the traditional care. Although cost can curb the mass application in resources constrained environments, such innovations indicate the changing frontier of asthma care.[16]

Moreover, the choice of devices is a highly important factor in reducing errors in techniques. In spite of the popularity of MDIs, they necessitate extensive coordination of hand breathing. Spacers with pressurized MDIs have the potential to significantly reduce the errors of coordination and enhance the deposition of drugs. Newman et al. demonstrated that aerosol delivery of drugs was improved with the use of spacers and oropharyngeal deposition was minimized. It is necessary to encourage clinicians to prescribe spacers regularly, especially with old people and those who have shown persistent mistakes.[17]

Training of healthcare providers is also very important. Research has shown that a significant number of the healthcare professionals themselves cannot exhibit proper inhaler technique. According to Lavorini et al., a significant percentage of doctors and nurses made mistakes in the use of inhalers . This brings out the need of making sure that the healthcare providers are properly trained prior to patient education. Institutional protocols should include the use of the standardized training modules, visual aids and demonstration devices.[18]

Politically, inhaler technique assessment should be included in national asthma control programs as one of the quality indicators of care. Since inappropriate technique is a modifiable risk factor, specifically developed interventions will have significant effects on the outcomes at a relatively low cost. Educational interventions, counseling by the pharmacists and nurse-led asthma clinics have shown good outcomes in enhancing inhaler competency and exacerbations. In brief, the protracted results confirm that inadequate MDI method is a significant, but a manageable, obstacle to ideal asthmatics. The issue is not only about patient behavior but also represents a lack of systemic education, follow-up, and the selection of devices. To ensure a sustainable change, a complex intervention between patients, health care-givers, and policy-makers is required. With the emphasis on inhaler technique evaluation and lifelong learning, the decrease in the morbidity and the healthcare burden of asthma may be greatly reduced.

Limitation of Study:

This research has a number of limitations. As a cross-sectional observational research, it will only determine an association and not prove a causal relationship between poor asthma management and improper inhaler technique. The inhaler technique was tested at a single time point, which was not necessarily an indication of the long term patient behavior. The research was carried out in one tertiary care facility, which restricts the ability

to extend the results to the rural or primary care. Also, objective data including spirometry was not to be correlated with technique errors and lung function parameters.

Conclusion:

In this cross-sectional observational study, the proportion of improper metered-dose inhaler (MDI) technique was high among asthma patients with over three-quarters of participants having a critical error. Poor asthma control was strongly correlated with the incorrect usage of inhaler, which indicates that effective pharmacotherapy cannot be used without proper technique of drug delivery. Major mistakes like low coordination of actuation and inhalation and the inability to withhold breath are critical factors that may hinder drug deposition in the lungs, thus lowering the efficiency of treatment. The results highlight the high necessity of regular inhaler technique evaluation at any clinical contact.

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