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Original Research Article

Evaluating the technique of using MDI and DPI in patients with respiratory disease

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ABSTRACT

Context: Inhalation therapy plays a major role in treatment of respiratory diseases. Correct inhalation technique is crucial for effective clinical outcomes.
Aims: The aim of this study was to evaluate and analyse technique of use of Metered Dose Inhaler (MDI) and Dry Powder Inhaler (DPI) in patients with respiratory disease.
Settings and Design: This observational study was conducted at pulmonary outpatient department of a tertiary care hospital.
Materials and Methods: 30 patients were enrolled using convenience sampling. Participants' demographic and disease specific data was recorded. Participants were asked to use their inhaler just as they would at home. The technique of device use was observed and recorded using inhaler specific checklists. Data collected was analyzed using descriptive statistics.
Results: Out of 30 patients 26 were using MDI, 23 of which (92%) performed at least 1 error. Among 4 patients using DPI, 3 (75%) performed at least 1 error. Patients using MDI for more than 1 year performed less errors compared to those who had been using MDI for less than 1 year, however the difference observed was not significant (n=26, p= 0.304). 29 patients (96%) received education about inhaler device use. The most common incorrectly performed steps were "complete exhalation" and "breath hold."
Conclusions: 92% of MDI and 75% of DPI users made at least one error during the inhalation maneuver despite majority being educated about inhaler technique. The most frequently performed incorrect steps for MDI and DPI were "Complete exhalation" and "Breath hold".

1. Introduction

Chronic respiratory diseases (CRDs) are the leading cause of morbidity and mortality worldwide. Nearly 545 million people around the globe suffer from chronic respiratory disease.[1] CRDs are responsible for 7% of deaths worldwide and are responsible for reduced quality of life and loss of productivity.[2] According to WHO, Chronic Obstructive Pulmonary Disease (COPD) will become the third leading cause of death in the world by 2030. Together COPD and asthma are the second leading cause of death in Indian population aged 25-69 and account for 3% of the disability adjusted life years (DALYs) in India.[3] These findings reveal the great burden of chronic respiratory diseases on our health care system.

Obstructive airway diseases, including chronic obstructive pulmonary disease (COPD) and asthma, cause significant mortality and morbidity worldwide and in India. COPD is defined as "a common, preventable and treatable disease that is characterized by persistent

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respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases" (Global Initiative for Chronic Obstructive Diseases (GOLD).[4] Asthma is defined as "Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation" (Global initiative for Asthma (GINA).[5]

Inhaled medications have been available for many years for the treatment of lung diseases and are widely accepted as being the optimal route of administration of first-line therapy for asthma and chronic obstructive pulmonary diseases.Drug delivery directly to the lung provides direct access to the site of disease for treatment of respiratory diseases and avoids unwanted side effects of systemic drug delivery.[6] Devices used to deliver therapeutic agents as aerosols are based on one of the three platforms: nebulizers, pressurized metered-dose inhaler (p-MDI), and dry powder inhalers (DPIs). Although many devices are available in India pressurised metered dose inhalers (p-MDIs) and (DPIs) are the most frequently used inhaler devices.

Inhalation therapy can be used along with traditional chest physiotherapy techniques to enhance mucociliary clearance. Mucociliary clearance is impaired in patients with respiratory disease especially during exacerbations.[7] B agonist (terbutaline) and osmotic agents like mannitol given via inhaler devices has been show to improve mucociliary clearance in patients with respiratory disease.[8] 7% hypertonic saline with albuterol (given by MDI) lead to significant immediate improvement in mucus clearance in participants with respiratory disease.[9] Medication delivery in the form of aerosol is commonly used as an adjunct to chest physiotherapy to improve its effectiveness. Various physiotherapeutic interventions are prescribed after patients have administered daily medications. Physiotherapists are involved in treatment of patients with respiratory disease and as healthcare professionals they participate in education of patients about correct use of inhaler devices.

The GINA 2021 (Global Initiative for Asthma) and GOLD (Global Initiative for Chronic Obstructive Lung Disease) has stated that correct inhaler technique is a vital part of the treatment algorithm. The goals for treatment for Asthma and COPD is to achieve disease control, prevent future exacerbations and reduce mortality.[4,5] Based on large number of randomised control trials inhaled long-acting bronchodilators, beta-agonists and/or muscarinic antagonists associated or not with inhaled steroids have been recommended in treatment guidelines to prevent COPD and asthma exacerbations.[10] Incorrect use or misuse of inhaler devices affects the concentration of medication which should reach the smaller airways for clinical efficacy and this is associated with poor disease control, increased rate of exacerbations, reduced quality of life and increased healthcare resource utilization.[11] In many studies done in the past by various authors whose aim was to assess inhaler technique found out that majority of patients misused their inhalers.[12–24] To reduce the impact of chronic respiratory diseases one of the solutions is to reinforce correct technique of use of inhaler devices. Therefore, the aim of this study was to find out the lacunae in the technique of use of inhaler device in patients with respiratory diseases so that better patient education interventions can be formulated in future.

2. Materials and Methods

This observational study was conducted in a tertiary care hospital for a duration of 6 months (Dec 2020-May 2021). 32 participants who visited the pulmonary outpatient department were recruited using convenience sampling. 2 were excluded from the study and 30 participants with respiratory disease (27 COPD and 3 Asthma) were evaluated further. Participants above 18 years of age who were prescribed MDI or DPI and had been using the same for a minimum duration of 6 months were included in this study. Participants who were unable to use inhaler device by themselves were excluded from this study. Approval from Sancheti Institute for Orthopedics and Rehabilitation Ethics Committee (IEC-SIOR/Agenda 065/13 2021) was taken prior to data collection. Written informed consent was taken from the participants and purpose of the study was explained to each before assessing them. Sociodemographic data and disease specific data were collected and recorded in the case record form. Participants were asked to use their inhaler device just as they would at home. Their technique of use of inhaler device was observed and data was recorded in device specific checklists. Collected data was analyzed using descriptive statistics. The Mean and SD were calculated. Data was analyzed using the IBM SPSS version 26. Comparison between groups was carried out using the Mann Whitney U test. Results were considered significant at $p<0.05$.

3. Results

Total 30 patients with mean age 55 ± 15.85 years were recruited in this study of which 20 (67%) were males and 10 (33%) were females. 27 (92%) of subjects were diagnosed with COPD and 3 (8%) with asthma. Patients had a mean duration of disease of 9.85 ± 11 years. Majority of patients i.e., 26 (86%) were using MDI and 4 (14%) were using DPI. The average duration of use of inhaler device was 4.55 ± 7.72 years [Table 1]. Among the 30 participants 29 (96.66%) were taught correct inhaler technique by healthcare professionals and 1 (3.33%) was self-taught (by reading the instruction leaflet) [Table 2].

Among the 26 participants using MDI 23 (92%) of them made at least one error during the inhalation maneuver. Step no. 2 shaking was correctly performed by only 12(46%), step no. 4 complete exhalation was correctly performed by only 9 (34%), step no. 8 (slow deep inhalation) was correctly performed by 13 (50%) followed by step no. 9 (breath holding) which was correctly performed by 12(46%) of the subjects. 2 (7%) participants failed to keep a gap of 30-60s between two successive doses.

The most incorrectly performed step was step no. 4 (complete exhalation) and the least incorrectly performed step was step 7 (actuation) which was correctly performed by 22(84%) of participants. However, multiple actuations were observed in 5 (23%) subjects. Steps 1 (removes cap), 5 (Breath out away from MDI), 10 (Removes inhaler from mouth before breathing normally) and 12 (Repeats sequence for second dose) was correctly performed by all participants [Figure 1].

In the present study participants who were using MDI for more than 1 year made fewer number of errors as compared to participants using MDI for less than 1 year, however this difference was not statistically significant (p=0.304). Step no.1 (removes cap), step 3 (attaches inhaler to back of spacer), step 5 (breathes out away from MDI), step 6(places the mouthpiece between lips and teeth), step 10 (removes inhaler from mouth before breathing normally), step 12 (repeats sequence for second dose) was correctly performed by all the participants [Figure 2].

Out of the 4 participants using DPI, 3 (75%) made at least one error while using their device. The commonest incorrectly performed steps were (complete exhalation) and (breathe holding) [Figure 3]. Since number of participants using DPI was less (n = 4), further analysis between genders and age groups was not carried out.

Table 1: Demographic data (n=30)

Variables	Mean	SD
Age (years)	55	15.85
Duration of inhaler use (years)	4.55	7.72
Duration of disease (years)	9.85	11.00

SD: Standard Deviation

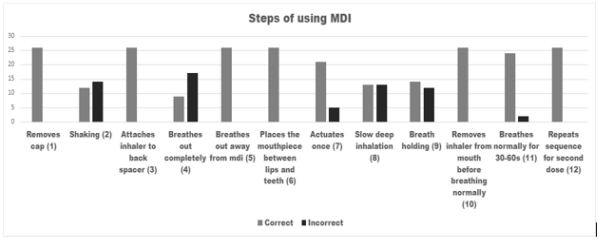
Table 2: Mode of education of inhaler technique (n=30)

Mode of education of inhaler technique	No. of Participants (n = 30)
1. Healthcare Professional.	29
2. Self-Taught	1

4. Discussion

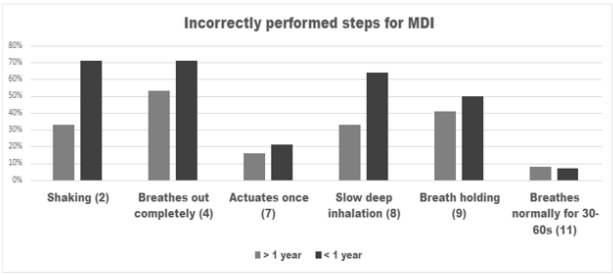
Inhalation therapy has been a cornerstone in the treatment of respiratory diseases due to direct delivery of drugs to the lungs and reduced systemic side effects. Inhalers should be used correctly in order for them to be clinically effective. MDI's and DPI's are by far the most commonly prescribed inhaler devices. MDIs consist of a canister which stores the drug and a metering valve they're compact, offer rapid delivery of drug and can be used independently, however MDIs are not easy to use. Previous studies have shown that participants using MDIs made more errors compared to participants using the DPI.[2]

In the present study, participants using MDI (n=26) were divided into 2 age groups >60 years and <60 years. Data showed that there was no difference in incorrect steps of inhaler technique between the two age groups (p=0.367). Similarly, there was no difference in incorrect steps of inhaler technique between the genders (p=0.245). A study



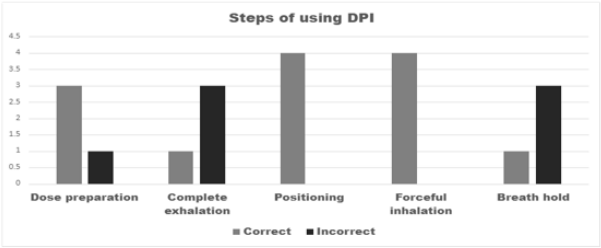
MDI: Metered Dose Inhaler

Fig. 1: Shows the stepwise distribution of errors in patients who were using the MDI.



MDI: Metered Dose Inhaler

Fig. 2: Represents the number of errors for each step of using MDI of participants using MDI for more than 1 year and less than 1 year



DPI: Dry Powder Inhaler

Fig. 3: Shows the stepwise distribution of errors in patients who were using DPI

done by Dalal S et al., in which the mean age of participants was 52.5 years also reported no associations of age and gender on correct inhaler technique.[21] Conversely in a study conducted by Melani et al., in a larger population group (n=1664) with mean age of 62 years observed that risk of critical inhaler device errors increased with age.[20] This discrepancy in results could be due to the difference in the mean age of the involved participants. In the present study 92% of MDI users made at least one error and 75% of DPI users made at least one error. However, the number of subjects using each type of device was not equal. The present study found out that the most common error for the MDI were "not shaking the inhaler (54%), Failure to exhale before actuation (66%) followed by Poor coordination between actuation and inhalation (50%) as shown in Figure 1. This data is comparable with study done by Sehjpal et al., where 78.82% of participant made errors in the inhalation maneuver. The most common error in this study was exhalation (65.88%) and breath holding (45.88%). Research studies have proved that these steps are essential for maximum drug deposition in the airways.[17] For the DPI the most incorrectly performed step was complete exhalation 3(75%) followed by breath holding 3(75%), incorrect method in dose preparation was seen in 1 (25%) as shown in Figure 3. A study done by Shrestha et al., also reported similar findings where they found that the most frequent incorrect step performed was breathing out slowly followed by failure to hold breath after inhalation.[24]

In this study it was found that patients who were using MDI for more than a year had good inhaler technique compared to patients using the inhaler for less than a year as shown in Figure 2. This observation could be explained by the greater number of follow up visits completed by patients who had a longer duration of therapy. A study done by Sen et al., has also revealed similar findings.[25] Longer duration of disease may require the patient to use the device greater number of times thereby increasing their proficiency in device use. However, Arora et al., reported that longer duration of inhaler use was associated with a steep incline in device use errors. The study postulated that this increase may have been due to overconfidence of patients in their technique of use of inhaler devices.[18]

In the present study 29 (96%) of participants were trained in inhaler device use by a healthcare professional while 1 (33%) participant was self- taught (by reading instruction leaflet) [Table 2]. In spite of being taught how to use the device many participants still made errors. A study done by Arora et al., revealed almost identical findings, in which even though 98% of participants were educated in inhaler device use by various healthcare professionals 82.3% committed at least one error.[18] One possible explanation for these findings is that due to busy clinical setup doctors are not able to give undivided attention to each and every patient. Previous studies have described that absence of formal education regarding device use is associated with more risk of critical inhalation errors, while patients who had been checked at least once for mastering good inhalation technique had lower risk of critical errors.[20] This suggests that repetition and feedback on inhaler technique is necessary for reduction in errors. In the current study details of whether inhaler device technique was re-assessed during follow up visits was not checked. However, during data collection it was noted that several patients attending the pulmonary OPD failed to carry their inhaler device with them due to which healthcare professionals could not re-assess their technique.

Inhaler mishandling remains a potent issue as previously discussed. Incorrect use of inhalers is associated with increased healthcare costs and reduced quality of life. Previous studies have shown that inhaler mishandling is strongly associated with poor disease control and increased rate of exacerbation in asthma and COPD patients.[10,11] Education on how to correctly use the inhalers is crucial for good clinical outcomes. In the present study even though majority of patients were formally trained to use the inhaler device, the number of errors committed were high. This may indicate that the training provided was not sufficient enough or correct technique was not reinforced at subsequent follow up visits. It was observed that patients did not carry their inhalers during follow up visits therefore any deficiency in their understanding of correct technique were not revealed. Therefore, patients should be encouraged to carry their inhalers during their follow up visits, their technique should be observed and correct technique of use should be demonstrated to the patients instead of only verbal instructions. A regular follow up system may reduce healthcare costs and improve disease control.

5. Conclusions

Majority (96%) of the study population received education about inhaler device use. 92% of MDI and 75% of DPI users made at least one error during the inhalation maneuver. The most frequently performed incorrect steps for MDI and DPI were "Complete exhalation" and "Breath hold".

6. Acknowledgement

None

7. Conflict of Interest

The authors declare no conflict of interest

8. Source of Funding

None.

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