International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 03-07-2020; Accepted: 19-07-2020; Published: 31-07-2020
www.medicalsciencejournal.com
Volume 6; Issue 8s; 2020; Page No. 09-13

How properly are our children receiving inhalational therapy for bronchial asthma

Krishna Keshav[1], Girijanand Jha[2], Binod Kumar Singh[3], Saroj Kumar[4], Sushil Kumar Pathak[5]
[1, 2] Senior Resident, Department of Pediatrics, N.M.C.H, Patna, Bihar, India
[3] Professor & H.O.D, Department of Pediatrics, N.M.C.H, Patna, Bihar, India
[4, 5] Assistant Professor, Department of Pediatrics, N.M.C.H, Patna, Bihar, India

Abstract
Background: Inhalational therapy is the mainstay of treatment in children with asthma. However, the use of inhalational therapy needs proper evaluation as poor handling of such devices and wrong inhalation technique are associated with decreased delivery of the drug and hence poor disease control. It is therefore important to overcome the drawbacks in inhalation technique by knowing the issues related to correct usage of these medical devices by children or their caregivers in Bronchial Asthma.
Methodology: We conducted this prospective observational study over a period of 1.5 years from January 2019 to June 2020 at O.P.D and Emergency of Pediatrics deptt at N.M.C.H, Patna including children of age 5-16 years with Bronchial asthma who were using inhalational devices for atleast one month.
Results: Mean age of the study population was 7.9 years (S.D 2.4 years). Male: Female ratio was 1.3:1. Mean age at diagnosis was 7.1 years (S.D 2.1 years). Mean duration of using the inhalational device was 6.2 months (S.D 1.7 months). Out of the 162 patients studied, only 27.2% could use their device properly. MDI was the commonest device being used (57.4%) followed by nebulizer (26.5%). However, MDI was also the most improperly used inhalational device (78.5%) while children receiving nebulisation therapy had the least number of errors (62.8%). The most common error in MDI was failure to shake the MDI, in DPI/Rotahaler it was inadequate breath accentuation and in nebulisation it was poor fitting of the mask. Children were educated about proper use of their device by a Doctor (54.9%) followed by nurses/hospital staffs (22.8%) & pharmacists (22.2%). In univariate analysis, we found following to significantly increase the risk of erroneous use: either parent being illiterate, low socioeconomic status, inhabitation in rural area, female sex, training about usage by personnel other than a Doctor and device usage for >3 months.
Conclusion: Majority of the children (62.8%) were not correctly using their inhalational devices. Proper education to patients/parents on correct usage may not only improve control of the symptoms of the disease but might also allow dose reduction in the long term.

Keywords: Bronchial asthma, error, inhalational therapy, DPI/Rotahaler, MDI, nebulizer, spacer

1. Introduction
Children with reactive airway disease or bronchial asthma constitute major chunk of patients visiting O.P.D/Emergency. Inhalation therapy remains the mainstay of treatment in such children both during exacerbation of their symptoms and during the maintenance phase of therapy [1]. Amount of drug actually reaching the lungs is determined by the technique of inhalation, type of the device used and the fine particle dose of the drug [2]. However, poor handling and wrong technique use leads to decreased medication delivery and hence poor disease control [3]. Types of inhalational devices available in the market include Metered Dose Inhaler (MDI), Dry Powder Inhaler (DPI), Metered Dose Inhaler with Spacer (MDI with Spacer), Breath actuated Metered Dose Inhaler (baMDI) and Nebulizer. Available literature on patients' handling of their usual inhaler devices in actual primary care or pulmonary clinical practice setting has shown that only few of them correctly use their devices [4]. The classic study on inhaler techniques done by Mollimard *et al*. [5] in over 3800 outpatients showed that around 50% of the subjects made at least one error when using a DPI. This erroneous use was even higher (76%) in case of MDI. Many other studies have Shown comparable high rates of error in use of such inhalation devices [6, 7]. It is therefore imperative on the part of the pediatricians and respiratory therapists to understand the issues related to correct usage of these devices and also to understand the difficulties faced by patients while using them. However, in our country, there is paucity of such data leading to incomplete understanding of the problem which makes the situation even more difficult to address. With this background and keeping in mind the burden of bronchial asthma in our children, we undertook this study to evaluate, analyse and address the issues related to proper usage of inhalational devices so as to decrease their sufferings.

2. Aim and Objectives
Aim
To study the correctness and problems in technique used for inhalational therapy at home by children &/or their parents.

Objectives
To study the types of inhalational devices used, their usage pattern, the errors committed while using such devices, nature of error observed and understanding the reason behind such errors.

3. Methodology

Study setting: O.P.D and Emergency room of Deptt of Pediatrics, N.M.C.H Patna

Study duration: 1.5 years, from January 2019 to June 2020.

Study design: Prospective observational study.

Inclusion criteria

children of age 5-16 years (both ages included) with Bronchial asthma who were using inhalational devices for relief &/or control of their disease for atleast one month who visited our O.P.D or ER for their primary disease or any other condition.

Exclusion criteria

Children with any condition or co-morbidity that could preclude the correct use of such devices (active T.B, musculoskeletal disease, neurological disease etc) were excluded.

Data Collection

After obtaining written informed consent, cases were enrolled in the present study. Information regarding baseline characteristics, relevant history, clinical examination, diagnosis, type of device used, frequency of administration and educator of the technique was recorded in a structured Performa. We interviewed and evaluated the enrolled subjects for the technique as given in the review by the European Respiratory Society [8] for their knowledge and correctness of the technique used. We also observed their administration technique during self-administration and recorded the interpretations. At our institute, we assigned a single investigator trained in device use to carry all such interviews in order to eliminate inter observer variability.

Statistical analysis

The data so collected was entered in Microsoft excel and analyzed using SPSS version 20 software. Variables were presented as mean, median, percentage, standard deviations as appropriate. Chi square test or Fishers exact test was applied for testing significance of difference. P value less than 0.05 was considered significant.

4. Observations and Results

During the study period, we enrolled 162 children with bronchial asthma who were prescribed inhalational therapy by their treating pediatrician. Mean age of the study population was 7.9 years (S. D= 2.4 years). 92 children were of male sex as compared to 70 of female sex. Male: Female ratio was 1.3:1. Mean age at diagnosis was 7.1 years (S. D= 2.1 years). Mean duration of using the inhalational device was 6.2 months (S. D= 1.7 months). Table 1 shows the general characteristics of the study participants.

Table 1: General characteristics of the participants

Characteristics	Number	Percent
Male sex	92	56.8%
Female Sex	70	43.2%
Chronological age: Mean (SD)	7.9 (2.4) years	-----
Age at diagnosis: Mean (SD)	7.1 (2.1) years	-----
Duration since treatment started	6.2 (1.7) months	-----
Rural inhabitation	103	63.6%
Urban inhabitation	59	36.4%
Low socioeconomic class	78	48.1%
Either parent being illiterate	23	14.2%

Type of inhalational device & usage pattern

56(34.6%) children were using MDI with spacer, 37 (22.8%) were using MDI with spacer & mask, 26(16%) were using DPI/Rotahaler and 43(26.5%) were using nebulisation therapy. Most of the children were educated about using their device by a Doctor (54.9%) followed by nurses/hospital staffs (22.8%) and pharmacists (22.2%). (refer Table 2)

Table 2: General characteristics of the different treatment groups.

Characteristics	MDI+ spacer (n= 56)	MDI+spacer+ Mask (n=37)	DPI/Rotahaler (n=26)	Nebuliser (n=43)
Mean age in years	8.6	5.9	10.2	8.1
Male Sex: n (%)	30 (53.6%)	22 (59.5%)	15 (57.7%)	25(58.1%)
Mean duration of treatment	6.4 months	6.9 months	5.9 months	5.5 months
Educator				
Pharmacist (total 36)	4	3	8	21
Nurse/hospital staff (total 37	11	9	9	8
Doctor (total 89)	41	25	9	14

Errors committed by children/caregivers while using their inhalation devices

Among the 162 cases studied, 72.8% (n = 118) made one or more error whereas only 27.2% (n = 44) could use their device properly without any error. Most improperly used device was MDI with spacer and mask 81.1% (n=30), followed by MDI with spacer 76.8% (n=43) & DPI/Rotahaler 69.2% (n=18). Whereas, the users of nebulizer committed the least number of errors (62.8%, n=27).

Types of error observed

1. **MDI with spacer users:** The most common errors were: “inhaler not shaken” in 66.1%, “poor seal around mouth piece” in 55.4%, “no/short breath hold” in 51.8% and “not exhaling to residual volume” in 48.2%.
2. **MDI with spacer and mask users:** The most common errors were: “inhaler not shaken” in 70.3%, “poor seal

around mouth piece" in 67.6%, "not keeping the system in situ for few seconds post pressing the MDI" in 56.8%.

3. **DPI/Rotahaler users:** The most common errors were: "Insufficient acceleration" in 65.4%, "not inhaling deeply enough" in 53.9% and "poor seal around mouth piece in 46.2% "Long delay before inhalation (36%)" and "Stopping inhalation as device is fired (32%)".
4. **Nebulizer users:** The commonest errors were: "poor fitting of the mask" in 67.4%, "no deep breathing throughout the treatment" in 62.8%, and "incorrect dose of medication" in 55.8%.

Table 3: Factors contributing to error

Factor	Error in the presence of factor	Error in the absence of that factor	*p* value
Either parent Illiterate	21/23= 91.3%	97/139= 69.8%	0.0320
Low socioeconomic class	68/78= 87.2%	50/84= 59.5%	0.0001
Female Gender	58/70= 82.8%	60/92= 65.2%	0.0130
Rural inhabitation	84/103= 81.5%	34/59= 57.6%	0.0010
Usage trained by non-doctor	66/73= 86.3%	55/89 = 61.8%	0.0005
Device use for < 3 months	77/93= 82.8%	41/69= 59.4%	0.0010

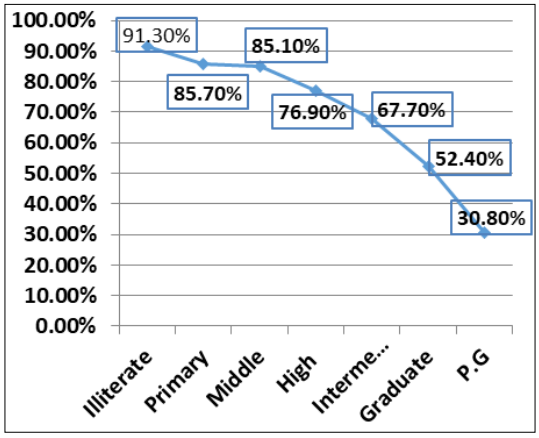

Fig 1: Education and error

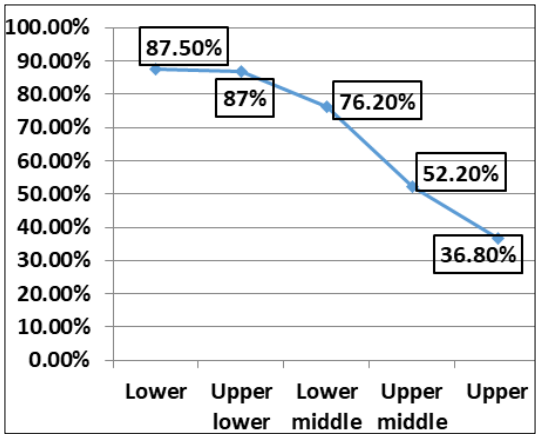

Fig 2: Socioeconomic status and error

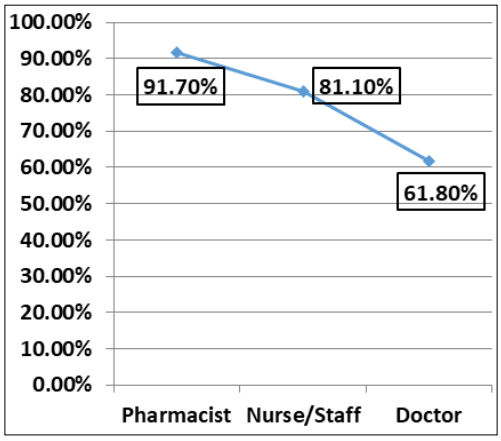

Fig 3: Educator and error

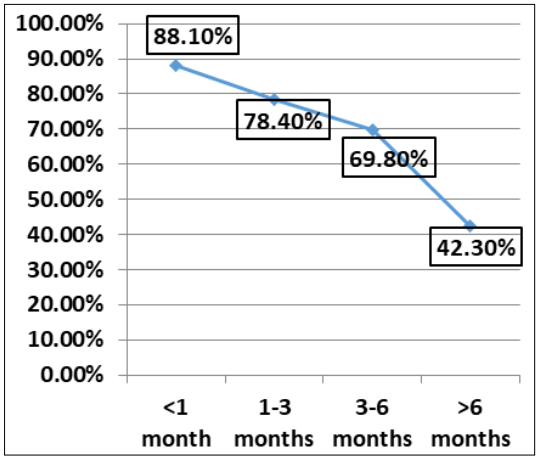

Fig 4: Duration of device use and error

5. Discussion

In the present study we intended to know the problem statement, pattern of wrong usage and reasons for improper use of inhalation devices so as to address the reasons behind the same. Here we found that using inhalational devices correctly is really a challenging task in Indian patients due to their educational and socio-economic background. Out of the 162 patients studied, only 27.2% could use their device properly.

In our study, though male: female ratio was 1.3:1, this difference wasn't statistically significant. Mean age of the study population was 7.9 years (S. D= 2.4 years) which can be ascribed to the higher prevalence of reactive airway disease in younger children. Mean duration of device use was 6.2 months which indicates that the condition has a chronic pathology and hence treatment runs for moths. We also found that the major chunk of such children came from rural background (63.6%) and approx half (48.1%) of total children belonged to low socioeconomic strata of the society. This reflects that our hospital being a tertiary care centre caters not only to urban children but also to children from nearby rural regions. Overall, MDI was the commonest device being used (57.4%) followed by nebulizer (26.5%). However, it was also the most commonly improperly used inhalational device (78.5%). Whereas, children receiving nebulisation therapy had the least number of errors (62.8%). The most common error in MDI was failure to shake the MDI, in DPI/Rotahaler it was inadequate breath accentuation and in nebulisation it was poor fiiting of the mask. Our results are comparable with the findings of Flor *et al*. [9] Other authors have also shown that

the rate of error in using inhalational therapy decreases when devices other than MDIs are used [10]. However, if the technique is correct, drug delivery and clinical benefit is the same regardless of the device used [11]. In univariate analysis, we found a higher risk of improper use of inhalational therapy in the presence of: either parent being illiterate, low socioeconomic class, rural inhabitation, female sex, usage trained by personnel other than a Doctor and use of device for >3 months.

Melani S *et al*. [12] and Ana Carlo Carvalho *et al*. [13] found higher error rates in patients with low education levels and low socioeconomic status, which is similar to our finding. However, Hesselink *et al*. [14] found no significant association between errors committed by the patients and their socio-economic status. As almost 50% of our cases came from rural background with a low level of education and socioeconomic status, the rate of erroneous use of devices was high in our study. Comparison of duration of device usage and errors committed showed a steep decrease in number of errors in the group using a device for more than 3 months. Elif sen *et al*. [15] found that a longer duration of therapy was associated with a proper inhaler technique (p value<0.05). Gracia-Antequera *et al*. [16] have also found that parents/ children receiving instructions more than once over a period of time tend to improve their performance of handling inhaler devices. When we plotted the number of patients committing errors against the educator, a sharp decline was seen among patients/caregivers trained by a Doctor (61.8%). Whereas, the percentage of error was considerably higher when the educator was a pharmacist (91.7%) or nurses/hospital staff (81.1%). Fink and Rubin [17] in their commprehensive study also found maximum error rate among self-educated and least among individuals educated by doctor. However, such high rate of failure to correctly use their inhalational devices also points to the fact that the training provided to the patients/caregivers was not sufficient enough in reducing the rate of errors. Deficient knowledge on the part of the training provider might also have contributed, as observed in a study conducted in Spain [18] which showed only 14% physicians knew how to properly use MDI. Few other researchers have also shown that many healthcare professionals lack proper skill for teaching the correct use of inhalation devices [19]. Nevertheless, limited data about patients' understanding of inhalation technique and difficulties faced while using them might have contributed to the ineffective patient training.

6. Conclusion

Majority of the children (62.8%) were not correctly using their inhalational devices. Proper education about device usage is crucial in ensuring adequate delivery of drugs to lungs. Whatever be the chosen device, education from health caregivers has a major role in improving technique and compliance. Complete inhalation instructions and monitoring at each visit are crucial to ensure correct usage of inhalational devices by such children. A comprehensive training program, keeping in mind the patient's/parents' education, age and level of understanding, could address this issue.

7. Limitation

First limitation is that ours is a single centre study. Second limitation is the small number of patients studied because of which we couldn't perform a multivariate analysis.

8. Conlict of interest: None

9. Financial disclosure: The authors declare that the present study hasn't received any financial support.

10. References

1. Bousquet J, Mantzouranis E, Cruz AA, Ait-Khaled N, Baena-Cagnani CE, Bleecker ER, *et al*. Uniform definition of asthma severity, control, and exacerbations: document presented for the World Health Organization Consultation on Severe Asthma. J Allergy Clin Immunol. 2010; 126(5):926-38.
2. Pritchard J, Sharma R. Introduction: Inhaled drug delivery. J Aerosol Med. 2001; 14(1):S1-2.
3. Crompton GK, Barnes PJ, Broeders M, Corrigan C, Corbetta L, Dekhuijzen R, *et al*. The need to improve inhalation technique in Europe: a report from the Aerosol Drug Management Improvement Team. Respir Med. 2006; 100(9):1479-94.
4. Melani AS, Bonavia M, Cilenti V, Cinti C, Lodi M, Martucci P, *et al*. Inhaler mishandling remains common in real life and is associated with reduced disease control. Respir Med, 2011; 105:930-38.
5. Molimard M, Raherison C, Lignot S, Depont F, Abouelfath A, Moore N, *et al*. Assessment of handling of inhaler devices in real life: an observational study in 3811 patients in primary care. J Aerosol Med. 2003; 16(3):249-54.
6. Hilton S. An audit of inhaler technique among asthma patients of 34 general practitioners. Br J Gen Pract, 1990; 40:505-6.
7. Sodhi MK. Incorrect inhaler techniques in Western India: still a common problem. Int J Res Med Sci. 2017; 5(8):3461-65.
8. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev, 2005; 14:102-108.
9. Flor Escriche X, Rodríguez Mas M, Gallego Alvarez L, Alvarez Luque I, Juvanteny Gorgals J, Fraga Martínez MM, *et al*. Do our asthma patients still use inhalers incorrectly? [Article in Spanish]. Aten Primaria. 2003; 32(5):269-74.
10. Brocklebank D, Ram F, Wright J, Barry P, Cates C, Davies L, *et al*. Comparison of the effectiveness of inhaler devices in asthma and chronic obstructive airways disease: a systematic review of the literature. Health Technol Assess. 2001; 5(26):1-149.
11. Haughney J, Price D, Barnes NC, Virchow JC, Roche N, Chrystyn H, *et al*. Choosing inhaler devices for people with asthma: current knowledge and outstanding research needs. Respir Med. 2010; 104(9):1237-45.
12. Melani AS. Inhalatory therapy training: a priority challenge for the physician. Acta Biomed. 2007; 78(3):233-45.
13. Coelho ACC, Souza-Machado A, Leite M, Almeida P, Castro L, Cruz CS, *et al*. Use of inhaler devices and asthma control in severe asthma patients at a referral center in the city of Salvador, Brazil. J Bras Pneumol. 2011; 37(6):720-28.
14. Hesselink AE, Penninx BW, Wijnhoven HA, Kriegsman DM, van Eijk JT. Determinants of an incorrect inhalation technique in patients with asthma or COPD. Scand J Prim Health Care. 2001; 19(4):255-60.

15. Şen E, Gönüllü U, Ekici Z, Kurşun N. Assessment of inhaler technique and treatment compliance of hospitalized patients and outpatients in a university hospital. J Ankara Univ Fac Med, 2006; 59:1-6.
16. Gracia-Antequera M, Morales Suarez-Varela MM. An intervention to improve the inhalatory technique of children and adolescents with asthma. Allergol Immunopathol, 1999; 27:255-60.
17. Fink JB, Rubin BK. Problems with inhaler use: a call for improved clinician and patient education. Respir Care. 2005; 50(10):1360-74
18. Plaza V, Sanchis J, Roura P, Molina J, Calle M, Quirce S, *et al*. Physicians' knowledge of inhaler devices and inhalation techniques remains poor in Spain. J Aerosol Med Pulm Drug Deliv, 2012; 25:16-22.
19. Rau JL. Practical problems with aerosol therapy in COPD. Respir Care. 2006; 51(2):158-72.