Clinical Efficacy of Salbutamol Delivered Via Nebulizer Versus Metered Dose Inhaler with Spacer and Mask in Wheezing Children"

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Abstract

Objective: To evaluate the clinical effectiveness of salbutamol administered by nebulizer versus metered dose inhaler with mask and spacer in wheezing children study **design:** Randomized clinical trial place **and Duration:** National Institute of Child Health, Karachi from 15th February to 14th August 2022 **Methodology:** There were 128 patients overall with acute wheeze. A history of wheezing duration was obtained. Two groups were formed. Salbutamol was administered through a nebulizer to Group-A. Salbutamol was administered to Group B using a metering inhaler, spacer, and mask. Clinical effectiveness was assessed. A p-value of 0.05 was considered significant when comparing the clinical efficacy of the two groups using the chi-square test. **Results:** A total of 54.7% male and 45.3% female patients made up group A. There were 42.2% female patients and 57.8% male patients in group B. Groups A and B had mean ages of 2.93 ±1.37 and 3.23± 1.15, years respectively. The average wheezing time for groups A and B was 1.46 ±1.08 and 1.10 ±0.50 hours, respectively. Clinical effectiveness in our study was 95.3% in group B and 81.3% in group A. Clinical efficacy was significantly associated across research groups. **Conclusion:** Clinical efficacy of the nebulizer was significantly low as compared to metered dose inhaler with a mask and spacer.

Keywords: Clinical Efficacy, Salbutamol, Nebulizer, Metered Dose Inhaler, Spacer, Mask, Wheezing

1. Introduction

The most favored way to administer asthma drugs is by inhalation therapy. Among the most popular modalities are nebulizers (for drugs in solution) and metered-dose inhalers. According to numerous studies, MDI-spacers can administer aerosols to children just as well as or even better than nebulizers. [1-5] Nebulizers utilize take longer, are less portable, are often more expensive, need more maintenance, and require more monitoring. They also require a power source. [6]

Contrary to that, spacers are more convenient to use than nebulizers, take less time and effort to operate, don't need

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electricity to distribute dosages, are portable, and need smaller quantities of medication. [7] Nebulizers can significantly affect the prevention of infections. Nebulizer use has been linked to a significant SARS outbreak that occurred in Hong Kong in March 2003. [8]

Because a respiratory therapist is necessary to oversee treatment sessions, using nebulizers for hospitalized children in some hospitals necessitates additional financial and human resources. Despite these facts, nebulizers are still often used to give bronchodilators and inhaled corticosteroids to children who are in hospitals. [9-10]

The majority of asthma recommendations, including the just-released Saudi Initiative for Asthma (SINA) recommendations, advise using inhalers for children even less than 6 years old. [11-13] In research, 5 out of 83 children in the spacer group and 20 out of 85 children in the nebulizer group were admitted to the hospital. [14]

The study's justification is the lack of recent local data on this subject in Pakistan. As respiratory issues are becoming more prevalent in our nation, particularly in Karachi, the current study is an effort in this direction. It will produce data that may be used to evaluate the best modality for usage in this resource-poor nation. By doing so, hospital bed occupancy and morbidity related to wheezing could be decreased.

2. Methodology

This Randomized clinical trial was conducted at the NICH, Karachi from 15th February to 14th August 2022. Non-probability consecutive sampling was used for the study. The total sample size is 128 patients that are 64 patients /group (Proportion of admission in the Nebulizer group=0.235[11], the proportion of admission in the MDI group=0.0602[11], Level of significance=5% and Power of the test=80%). No admission after 1 hour of treatment was taken as an efficacy.

Children between 01 to 5 years of either gender presenting with acute wheezing assessed on clinical examination and duration of wheezing within 6 hours of presentation were included in this study. Children having congenital airway abnormalities, chronic lung disease, Respiratory failure and who received salbutamol within 6 hours prior to the study were excluded.

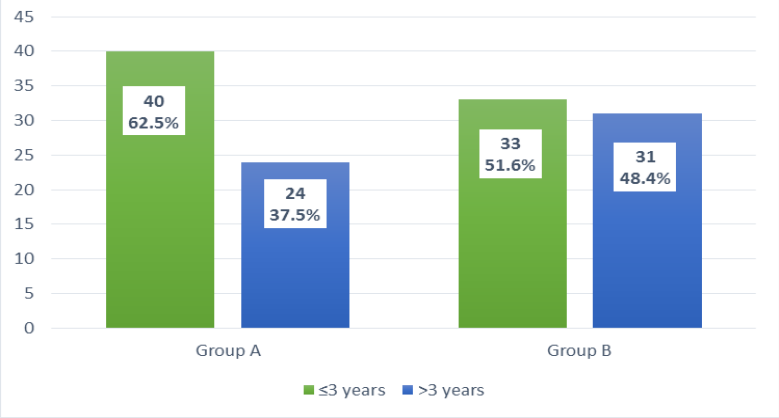
Children who met the inclusion criteria and were taken to the emergency room or outpatient clinic were included in the study. Their parents or guardians gave their informed consent so they could participate in the study. A history of wheezing duration was obtained. The SNOSE protocol was followed to form two groups. Following the parental selection of one envelope, the children in Groups A and B received salbutamol by the nebulizer and metered-dose inhaler, respectively. The proforma included demographic information, such as age, gender, and weight, as well as the outcome variable, clinical efficacy. The operational definition was used to label clinical efficacy.

On SPSS version 20, data entry and analysis were completed. Age, wheeze duration, and infant weight were all continuous data that were reported as mean±SD. Clinical effectiveness and other categorical data were reported as frequencies and percentages. The chi-square test was used to compare the clinical efficacy of the two groups, and a p-value of 0.05 was deemed significant. To see how these factors affected the outcome, efficacy, age, gender, and weight stratification was used to control modifiers and confounders. After stratification, the chi-square test was applied.

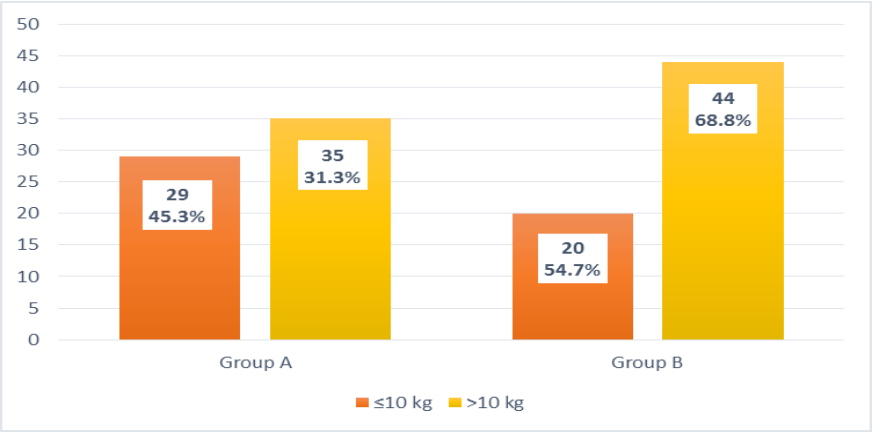
3. Results

In order to compare the clinical effectiveness of salbutamol delivered via nebulizer vs. metered dose inhaler in wheezing children, a total of 128 patients of either gender with ages ranging from 1 year to 5 years who met the study's inclusion criteria were included in the study. In both study groups, Group A (nebulizer) and Group B (metered dose inhaler) 64 patients were included. In group A there were 54.7% males and 45.3% females and in group B, there were 57.8% males and 42.2% females. In group, A and group B, the mean age was 2.93±1.37 years and 3.23±1.15 years respectively.

The mean weight in group A and group B was 10.36±2.93 kg and 10.82±2.11 kg respectively. The mean duration of wheezing in group A and group B was 1.46±1.08 hours and 1.10±0.50 hours respectively. In our study, clinical efficacy in group A was 81.3% and 95.3% in group B (As shown in Table 1). The two groups were compared by using the chi-square test for clinical efficacy (As shown in Table 2). Stratification was also done for gender, age and weight to compare the two groups for clinical efficacy. The results found a significant association of clinical efficacy with the study group (p=0.013) (As shown in Table 3).



GRAPH – 1: AGE GROUP OF STUDY PARTICIPANTS (n=128)



GRAPH – 2: WEIGHT GROUP OF STUDY PARTICIPANTS (n=128)

TABLE 1: DISTRIBUTION OF CLINICAL EFFICACY (n=128)		
	Frequency (%)	
	Group A	Group B
Yes	52 (81.3)	61 (95.3)
No	12 (18.8)	3 (4.7)
TOTAL	64	64

TABLE 2: FREQUENCY OF STUDY GROUP ACCORDING TO CLINICAL EFFICACY (n=128)				
CLINICAL EFFICACY	STUDY GROUP		TOTAL	P-Value
	Group A	Group B		
Yes	52 (46)	61 (54)	113	0.013*
No	12 (80)	3 (20)	15	
TOTAL	64	64	128	

TABLE 3: STUDY GROUP ACCORDING TO CLINICAL EFFICACY FOR VARIOUS FACTORS				
Males	Group A	Group B	Total	P-value
Yes	29 (44.6)	36 (54.4)	65	0.039
No	6 (85.7)	1 (14.3)	7	
Females				
Yes	23 (47.9)	2 (25)	48	0.156
No	6 (75)	2 (25)	8	
Age ≤3 years				
Yes	33 (52.4)	30 (47.6)	63	0.298
No	7 (70)	3 (30)	10	
Age >3 years				
Yes	19 (38)	31 (62)	50	0.008
No	5 (100)	0 (0)	5	
Weight ≤10 kg				
Yes	25 (56.8)	19 (43.2)	44	0.318
No	4 (80)	1 (20)	5	
Weight >10 kg				
Yes	27 (39.1)	42 (60.9)	69	0.015
No	8 (80)	2 (20)	10	

4. Discussion

The goal of the study was to compare the clinical efficacy of salbutamol given to wheezing children using a metered dose inhaler and a nebulizer. Prior studies employing a clinical score have demonstrated the efficacy of beta-2 agonists administered by metered-dose inhaler (MDI) with a spacer and a face mask in treating acute wheezing exacerbations in infants [16, 17] and children. [18]
Furthermore, studies on adults and children older than 2 years old have shown that beta-2 agonists administered via MDI with a spacer device and a face mask are just as effective as nebulization in treating asthma or acute wheezing attacks and have fewer adverse effects (tachycardia, vomiting, and oxygen desaturation) than salbutamol administered via nebulizer. [19-24]
In research, there were 17 children in the nebulizer group and 19 in the inhaler group who were wheezing for the first time. In the previous 48 hours, 24.6% of children in the nebulization group and 27.4% of children in the inhaler group had taken anti-asthmatic drugs. Additionally, both groups' symptom durations before the current wheezing episode were comparable. A patient from the nebulization group had to be hospitalized since their treatment had failed. Three children in the nebulization group and one in the inhaler group were reported to have temporary tremors, but neither child's condition got worse after either treatment. Results are consistent with prior studies in terms of success within the first hour of therapy, where success was 90% in the inhaler group against 71% in the nebulization group. However, both techniques were 99.2% successful after two hours of treatment. [15]
Another study used the nebulized salbutamol dose of 0.25 mg/kg weight, with a maximum dose of 5 mg, whereas other trials employed larger doses. A wide range of beta-2-agonist dosages administered by inhaler versus via nebulizer was seen in prior trials (ratio from 1:1 to 1:10). [18, 19]
When treating an acute asthma exacerbation, Kerem et al.[20] found that salbutamol given by inhaler had the same efficacy (as measured by a clinical score) and fewer side effects (tachycardia) than salbutamol provided via nebulizer. Similar to this, Chou et al.[21] found that albuterol delivered via MDI with a spacer and mouthpiece or face mask provided the same effectiveness as salbutamol delivered via nebulizer with a shorter delivery time and less adverse effects. A total of 152 children older than 2 with an acute asthma exacerbation participated in the trial. [21]
In research, individuals who got salbutamol via MDI with a spacer experienced quicker improvement than those who received the medication by nebulizer. [15]
Furthermore, Parkin et al.[4] demonstrated that

salbutamol supplied by inhaler was just as effective as when administered by a nebulizer in their study of 60 hospitalized children under the age of five with moderate acute asthma. During the two weeks of follow-up in that trial, the incidence of recurrence was comparable in both groups.

In a randomized study with 111 children aged 5 to 16 with asthmatic crises, a beta-2 agonist delivered by inhaler was shown to be superior (based on forced expired volume in 1 sec and peak expired flow) and to be associated with fewer adverse effects (desaturation) than when delivered by nebulizer.[22]

In babies with acute wheezing, Closa et al. observed that terbutaline given via an MDI with a spacer had the same effect as when the medication was given via nebulizer (based on a clinical score and pulse oximeter). Nebulizers are more expensive, more difficult to use, and require electricity, which are additional distinctions between using one vs an inhaler. [20-22]

It is also a well-known entity that using a nebulizer is an ineffective way to administer medication; up to 90% of the dose either stays inside the device or escapes into the atmosphere. [20] The type of nebulizer, and the solutions used, are just a few of the numerous variables that affect how effective drugs are delivered using nebulizers. An inhaler provides extra advantages when big populations are being treated in a primary care facility. [24]

In comparison to nebulizers, inhalers are easier to use, smaller, and more portable, and they require less time to provide treatment. [20-22] The inhaler is also less expensive than a nebulizer, and it may be used at home or in the emergency room following sterilization. In a sizable adult tertiary care facility, Bowton et al [25] noted a 25% decrease in monthly costs following the use of MDIs instead of nebulizers. It has been proven that the usage of MDI systems in paediatric emergency departments and health centres aids in the teaching of proper inhalation procedures to young patients. [26] The use of inhalers with masks removes young children's incapacity to coordinate aerosol administration with inspiration and consequently promotes aerosol deposition in the lung. [25] However, recent studies have revealed significant within-subject variability in children using MDI-S with plastic or metal spacers at home, [26] underscoring the significance of understanding the functionality of the various inhalation devices[26] and the proper dosages of the medication[27] in order to optimize treatment. Therefore, all of these issues are significant aspects that must be taken into account while managing a common symptom like wheezing. [28]

5. Study limitations

The current study used a single hospital as its setting and had a modest sample size. Because the study was conducted in an urban setting, it's possible that the findings don't apply to bigger populations.

6. Conclusion

The clinical efficacy of Salbutamol delivered via nebulizer was significantly low (81.3%) as compared to the efficacy of metered dose inhaler (95.3%) with a spacer and mask. Children under 5 years of age responded faster to salbutamol delivered by a metered dose inhaler, a spacer and a face mask than when delivered by nebulizer.

7. Funding source

None

8. Conflict of interest

The authors have NO affiliations with or involvement in any organization with any financial interest or nonfinancial interest in the subject matter or materials discussed in this manuscript.

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