Original Article

Efficacy of inhaled salbutamol therapy through nebulizer versus mdi with spacer in children with acute asthmatic attack and short-term course

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ABSTRACT

Introduction: Asthma is a common chronic disease in childhood and has been subject of studies for at least two decades, due to its increasing prevalence. The symptoms are persistent, recurrent, and entirely related to bronchial hyper-responsiveness to many environmental triggers. Nebulization and metered dose inhaler (MDI) are two available modalities of salbutamol administration in patients with acute asthmatic attack. **Aim:** The aim of the study was to compare the relative efficacy of nebulizer and MDI with spacer for the administration of salbutamol in the treatment of acute asthmatic attack. **Materials and Methods:** A randomized, prospective, and interventional study was conducted on 100 children aged 1–12 years with acute asthmatic attack at a tertiary care. The subjects were randomized into two groups for salbutamol administration. Group I was given salbutamol by nebulizer and Group II by MDI with spacer. Demographic data and detailed history was collected. Children were categorized into mild, moderate, and severe grade according to peak expiratory flow rate (PEFR) and pulmonary index (PI) score. Oxygen saturation, PEFR, and PI were monitored at 0, 20, 40, and 60 min of therapy. Other details such as duration of hospital stay and oxygen requirement were also noted. **Results:** One hundred children with male female ratio of 1.12:1 were included in the study. Highest incidence was seen in age group of 1–3 years (38%). Statistically significant change in PI and PEFR was noted with treatment in both the groups ($p<0.05$). On comparison between MDI and nebulizer group, no statistically significant difference was found ($p>0.05$). **Conclusion:** MDI with spacer is an effective alternative to nebulizer for the administration of salbutamol drug in acute asthmatic attack in pediatric patients.

Key words: Bronchial asthma, Metered dose inhaler, Nebulizer, Peak expiratory flow rate, Salbutamol and pulmonary index

Asthma affects almost 300 million individuals worldwide. It is a serious global health problem affecting all age groups, with increasing prevalence in many developing countries leading to rising treatment cost, along with rising health burden for patients [1].

Asthma is a Type 1 hypersensitivity reaction where combination of allergens with IgE antibodies produces airway hyper responsiveness, airway obstruction, and other inflammatory symptoms.

Along with the genetics, environmental risk factors are also implicated in the disease onset such as exposure to dust, pets, cockroaches, mold, fungi, viruses, grass, and others [2].

Nebulizers and metered dose inhalers (MDI) are being used to administer bronchodilators in patients with asthma. Nebulizers are expensive and their preparation and use are time-consuming, they require electric power. Dose-metered inhalers with spacers are more economic, easy to use, do not require electric power, and deliver bronchodilators to the lower airways as efficiently as do nebulizers.

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Aim of the Study

The aim of the study is to study the efficacy of inhaled salbutamol therapy through nebulizer versus MDI with spacer in children with acute asthmatic attack and also to know the short-term outcome in acute asthmatic children in terms of duration of oxygen therapy, change in Peak expiratory flow rate (PEFR) in these children, and duration of hospital stay.

MATERIALS AND METHODS

This study was conducted in Department of Pediatrics, MLB Medical College Jhansi on 100 children with acute asthmatic attack for a period of October 2019 to June 2020. Clearance

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from the ethical committee of the institution was taken before the commencement of the study. The children included in the study were randomized in two groups using computer generated random number table.

Children with age group of 1–12 years of age presenting with acute asthmatic attack, children with known case of bronchial asthma, and children whose parents/guardian gave the consent for the study were included in this study.

Diagnosis of bronchial asthma was done by Global Initiative for Asthma guidelines (2019) [3].

Children with history of any other lung disease such as pulmonary tuberculosis, lung abscess, bronchiectasis, eosinophilic lung diseases (Tropical pulmonary eosinophilia, Churg-Strauss disease, and eosinophilic pneumonia) were excluded from the study. Any chest wall injury or deformity and also children with congenital anomalies including congenital heart disease or cystic fibrosis, any chest wall deformity, injury, systemic comorbidity such as hypertension or diabetes mellitus, history of parasitic infestation, human immunodeficiency virus infection, and viral infection immunosuppression from other causes were excluded from this study.

Table 1: Demographic data of studied children

Age group (in years)	Nebulizer		MDI		Total	
	No.	%	No.	%	No.	%
1–3	18	36.0	20	40.0	38	38.0
3–6	14	28.0	13	26.0	27	27.0
6–9	7	14.0	8	16.0	15	15.0
9–12	11	22.0	9	18.0	20	20.0
Sex						
Male	27	54.0	26	52.0	53	53.0
Female	23	46.0	24	48.0	47	47.0
Presenting complaints						
Cough	38	76.0	40	80.0	78	78.0
Wheezing	29	58.0	25	50.0	54	54.0
Increase respiratory rate	50	100.0	47	94.0	97	97.0
Fever	0	0	3	6.0	3	3.0
Family history						
Present	11	22.0	15	30.0	26	26.0
Absent	39	78.0	35	70.0	74	74.0
Allergic history						
Present	24	48.0	28	56.0	52	52.0
Absent	26	52.0	22	44.0	48	48.0

Methods

Informed written consent was taken from parents/guardian. A random number table was used to assign patient into two groups. Group I comprised of 50 children with acute asthmatic attack who received salbutamol nebulization of standard dose of 0.15 mg/kg in 3 ml of normal saline. Group II comprised of 50 children with acute asthmatic attack and received salbutamol through MDI 3 puffs of 100 microgram/puff at interval of 0, 20, and 40 min.

Assessment

Clinical measurement included room air oxygen saturation measured by pulse oximeter, heart rate, and pulmonary index (PI) score. PI score is a validated asthma severity score that includes four measures, each score from 0 to 3 [4].

RESULTS

In our study, 100 patient of bronchial asthma was studied aged 1–12 years. Male to female ratio for asthma in the present study was 1.12:1. Most patients belonged to age group 1–3 years and the most common presenting complain was increase respiratory rate followed by cough and wheezing. Family history of asthma was present in 26% patients and allergic history in 52%. Statistically significant change in PI and PEFR occurred after nebulization and MDI, the most of the patient shifted from severe-to-moderate-to-mild case. The result are specified the Tables 1-4.

DISCUSSION

In the present study, 100 patients with bronchial asthma were studied aged 1–12 years. Maximum 38 (38%) belonged in the age group 1–3 years and 27 (27%) were of age group 3–6 years and 20 (20%) were in age group 9–12 years. This is in accordance with study by National Pediatric Asthma Collaborative Group in 2013 [5], which showed that preschool children (3–5 years old) had the highest prevalence of asthma (4.15%), which was significantly higher than that of school-age children (6–14 years old, 2.82%) and infants (0–2 years old, 1.77%). Another study by Rachel A Winer *et al.* (2012) [6] which suggests that asthma incidence among at-risk children was 12.5/1000. Incidence among children aged 0–4 years was 23.4/1000, more than 5 times greater than that among youth aged 12–17 years (4.4/1000).

Table 2: Change in pulmonary index after the treatment in children (1–5 years of age)

Pulmonary index	Change in pulmonary index			
	Nebulizer (n=23)		MDI (n=24)	
	Before treatment	After treatment	Before treatment	After treatment
0–3 (Mild)	2	11	1	8
4–6 (Moderate)	5	10	7	15
7–9 (Severe)	16	2	16	1
p-value	Chi-square is 32.4522. p<0.00001. Significant at $P<0.05$.		Chi-square is 22.4283. p=0.000012. Significant at $P<0.05$	

Table 3: Comparison of change in pulmonary index and percentage change in PEFR after treatment in children (1–5 years of age) in nebulizer and MDI

Pulmonary index	Change in pulmonary index	
	Nebulizer (n=23)	MDI (n=24)
	After treatment	After treatment
0–3 (Mild)	11	8
4–6 (Moderate)	10	15
7–9 (Severe)	2	1
p-value	Chi-square statistic is 1.7062. *P* value is 0.426086, Not significant at *P*<0.05.	
PEFR	**Change in % of PEFR**	
	Nebulizer (n=23)	MDI (n=24)
	After treatment	After treatment
Mild (>80%)	2	4
Moderate (60–80%)	16	16
Severe (<60%)	5	4
p-value	Chi-square statistic is 0.7568. *P* value is 0.684941 Not significant at *P*<0.05.	

MDI: Metered dose inhalers, PEFR: Peak expiratory flow rate

Table 4: Mean duration of hospital stay

Mode of Drug administration	Mean duration of hospital stay	p-value
Nebulizer	4.14	*t*-value is 0.19024. P=0.424756. (Not significant)
MDI	4.08	

The M: F ratio for asthma in present study was 1.1:1. The male predominance in the study population was almost in accordance to a similar study done by Singh *et al*., in 2002 [7] in rural children with chronic/recurrent cough, in which the M: F ratio was 1.4:1. Kabra *et al*., (2000) [8] observed that there was male dominance in all age groups with male to female ratio of 2:1. Similar result was found in different studies conducted by other authors [9-14].

The reason for male gender predominance during childhood is not known. It could be due to gender wise difference in airways patency due to hormonal differences or also due to gender-wise discrimination in Indian society.

In our study, 97% of cases were found to have increased respiratory rate followed by cough 78% and 54% wheezing.

In our study, 52% of cases were found to have an allergic history and 48% of cases were found to have no allergic history. On comparing group-wise, 48% cases were found in nebulizer group and 56% cases were found in MDI group who had a positive allergic history.

In our study, 67% cases did not have previous history of treatment and only 33% cases had previous treatment of history with asthma.

According to Van Aalderen *et al.,*1993 [15] study, asthma symptoms include recurrent wheezing, coughing, chest tightness, and dyspnea, with nightly and early morning symptoms being more prevalent, whereby quality of life is often reduced.

Symptoms of asthma may already occur early in life, with approximately a third of children wheezing during their first 3 years of life [16]. While the majority of these children will have stopped wheezing by the age of six, 40% will continue to wheeze, having already developed asthma or developing asthma at a later stage in life.

In our study, 47 cases out of 100 cases were children between 1 and 5 years of age. In which 23 were from nebulizer and 24 were MDI group.

In nebulizer group, two cases of mild asthmatic attack children found in study, five cases were from moderate asthmatic attack, and 16 cases of severe asthmatic attack. After the treatment, 11 cases were found to be mild asthma, 10 cases were moderate, and two cases of severe asthma were found.

In MDI group, 16 cases were severe asthma, seven cases were moderate, and 1 with mild asthma. After the treatment, one case was found with severe, 15 cases were of moderate, and 8 cases were of mild asthma (p=0.000012) (p<0.05).

Schuh *et al*. (1999) [17] used albuterol administered through a nebulizer (0.15 mg/kg), and through a MDI with Aerochamber, 200 µg, and 600–1.000 µg. No significant difference was noted between the groups as to forced expiratory volume 1 variation [18-20].

There was no significant difference found in duration of hospital stay between two groups Nebulizer (4.14 days) versus MDI 4.08 (days) (p=0.424756.; Not significant).

The strength of this study is that we compared the two modalities of drug administration objectively using PI score and change in percentage PEFR. Duration of hospital stay was also compared between the two groups.

The limitation of this study was that the administrator of the drug was not blinded. The patients not responding to the initial treatment with salbutamol were further treated with other drugs according to protocol but were not analyzed according to the group assigned.

CONCLUSION

MDI and nebulizer both decrease the severity of acute bronchial asthma which is statistically significant. However, on comparing between MDI and nebulizer routes, no statistical difference was observed. Hence, we infer that both routes can be effectively used in children presenting with acute bronchial asthma.

For a developing country like ours, due to economic and power constraint, MDI spacer would be an effective alternative to nebulizer for administration of salbutamol in cases of acute asthmatic attack in pediatric emergency.

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