

EFFICACY AND COST COMPARISONS OF BRONCHODILATOR ADMINISTRATION BETWEEN MDI'S WITH A DISPOSABLE SPACER AND NEBULIZER FOR ACUTE ASTHMA TREATMENT

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Abstract

Background

Despite demonstration of equivalent efficacy of beta agonist delivery using MDI with spacer versus nebulizer in asthma patients, use of nebulizer remains the standard of practice. We hypothesize that beta agonist delivery with MDI/ disposable spacer (LiteAir) combination is as effective and low cost alternative than nebulizer delivery for acute asthma.

Methods

Prospective, randomized, double blinded, placebo controlled trial in the emergency department (ED) in 60 acute asthma patients. Subjects were randomized to receive albuterol with MDI/spacer combination or nebulizer. The spacer group (N=29) received albuterol by MDI using LiteAir followed by placebo nebulization. The nebulizer group (N=29) received placebo by MDI using LiteAir followed by albuterol nebulization. Peak flows, symptom scores and need for rescue bronchodilator were monitored.

Results

Patients in the two randomized groups had similar baseline characteristics. The severity of asthma exacerbation, median peak flows, and symptom scores were not significantly different between the two groups. The median improvement in peak flow was 120(75,180)/min versus 120(80,155)/min in the LiteAir and nebulizer groups, respectively (p= 0.56). The median improvement in the symptom score was 7(5,9) versus 7(4,9) in the LiteAir and nebulizer groups, respectively (p= 0.78). Median cost of treatment per patient was \$10.11 (interquartile range \$10.03-10.28) versus \$18.26 (interquartile range \$9.88-22.45) in the Lite Air and nebulizer groups, respectively (p<0.001).

Conclusion

Beta agonist delivery with MDI /spacer combination for management of acute asthma is an equally efficacious and more economical alternative to nebulizer delivery.

Introduction

Patients with acute asthma are usually treated with nebulized albuterol in the emergency department and in the inpatient setting after admission. An albuterol metered dose inhaler (MDI) with a spacer can be used alternatively. Spacers allow the patient to inhale aerosol from the MDI without the need to coordinate the actuation of MDI and inhalation, a step many patients have difficulty learning. Equivalent efficacy of albuterol MDI and nebulizer has been demonstrated in adults and children with airflow obstruction. The spacer/MDI combination has been evaluated in the adults with mild, moderate and severe acute asthma in various settings including the outpatient department, inpatient ward, emergency department, and intensive care settings. Although greater bronchodilator response might be expected with a nebulizer because of the higher dose used for nebulization compared with standard MDI inhalers, studies comparing a beta agonist MDI plus a spacer with a beta agonist nebulizer show no difference with respect to clinical response in acute severe asthma and stable chronic asthma. Albuterol administered by a spacer and MDI therefore may be an effective alternative to a nebulizer. It is well tolerated, easy to use, requires smaller doses of medication than a nebulizer and causes fewer side effects in children with moderate and severe asthma. In addition extra pulmonary sympathetic effects such as tremor, anxiety, and arrhythmias were found in one study to be more prevalent in patients receiving nebulized medication compared to MDI/spacer delivered medication.

Even though bronchodilator delivery with Nebulizer requires longer delivery times and greater personnel resources, nebulized albuterol remains the standard of therapy for patients with acute asthma. Despite the demonstrated equivalency and rapid delivery of MDI/spacer combination, the expense of non-disposable commercial spacers has limited their use in the emergency department or the inpatient setting. Inexpensive alternatives, such as a modified mineral water bottle (valveless homemade spacer), or a Zip-lock bag with a mouthpiece inserted into a corner, have been shown to be equally effective. A new inexpensive, disposable, collapsible, dual-valved holding chamber for use with MDI LiteAir, (Thayer Medical, Tucson, AZ) has recently become commercially available for use in the emergency department or inpatient setting for management of acute asthma. We hypothesize that albuterol delivered with LiteAir would be an efficient, cost effective alternative to nebulized albuterol treatment for asthma patients in the emergency department, where other commercial spacers are not used due to affordability.

Table 1a

Characteristic	LiteAir Group (n=29)	Nebulizer Group (n=29)	Total n=58	p*
Age(in years) (%)				.15
<30	35	52	43	
30-50	41	41	41	
>50	24	7	16	
Females (%)	83	59	71	.04
Race (%)				.47
African-American	38	52	45	
Caucasian	7	3	5	
Hispanic	55	41	48	
Other	0	3	2	
Unknown				
Intubation History (%)	10	7	9	.64
Asthma duration >10 years (%)	76	79	78	.75
Steroids administered in ER (%)	59	62	60	.79
Peak Flow Rate (L/min)	220 (165-315)	260 (190-360)	250 (180-343)	.37
Symptom score	8 (7-11)	9 (7-11)	9 (7-11)	.95

Study Design

Patients were randomly assigned to the study group (MDI/LiteAir spacer combination) or control group (Nebulizer). Codes for the study device were known only to the pharmacist and all personnel involved in patient recruitment and medication delivery were blinded to the randomization. All patients received treatment with both MDI /spacer combination and nebulizer. The LiteAir group (N=30) received 540 mcg of albuterol by MDI (six actuations of 90 mcg/actuation, Warwick Pharmaceutical Corporation, Reno NV) with the spacer (LiteAir) followed by a placebo nebulizer treatment (3 ml of .9% normal saline solution every one hour until disposition. The nebulizer group (N=30) received 6 actuations of placebo MDI with spacer (LiteAir) followed by 2.5mg (3ml) Albuterol (Dey, Napa, CA) by Nebulizer (Cardinal Health Edison, NJ) on a similar schedule. MDIs were shaken before each actuation and medication was administered one actuation at a time into the LiteAir spacer. Each actuation was delivered just before inhalation and the aerosol was inhaled from the spacer by 6 tidal breaths. Patients also received rescue treatments of nebulized albuterol as required. Oral or intravenous steroids were administered at the discretion of the ER physician.

A baseline peak flow and a 'symptom severity score' were recorded for each patient at the start of the study, and every 1 hour until disposition. Based on each patient's perception of severity of symptoms, a score of 0-3 was assigned, each for shortness of breath, chest tightness, wheezing and cough (0 for none, 1 for mild, 2 for moderate, 3 for severe), and a total score was calculated as the sum of each individual score, allowing a maximum of 12. A higher score reflected a greater severity of symptoms and decreasing score indicated improvement. Both groups were followed for their expiratory peak flow, symptom severity and the number of rescue bronchodilator treatments every hour for a maximum of 6 hours. The triage decision to admit or discharge a patient from the ED was made within 6 hours of enrollment into the study and the study was terminated once the patient was discharged home, or admitted to the hospital. Patients were discharged or admitted based on NAEPP guidelines.

Outcomes

The primary outcomes measured were change in patients' symptoms and peak flow rates, and disposition (i.e. admission to hospital or discharge to home from the emergency department). Secondary outcome measures were length of stay in the ED, cost of therapy and the number of rescue treatments. The length of stay was calculated from the time of enrollment into the study until the time the decision was made regarding patient's disposition. In the case of patients whose stay in the ED was prolonged for reasons other than medical, the time of disposition was taken as the time that they met the criteria for admission to the medical ward or discharge home. Cost analysis for each group included the cost of medication, equipment (spacer vs. nebulizer kit) and labor (time spent by the respiratory therapists in delivering albuterol via nebulizer vs. spacer).

Results

Characteristic	LiteAir group (n=29)	Nebulizer Group (n=29)	Total n=58	p*
Age(in years) (%)				.15
<30	35	52	43	
30-50	41	41	41	
>50	24	7	16	
Females (%)	83	59	71	.04
Race (%)				.47
African-American	38	52	45	
Caucasian	7	3	5	
Hispanic	55	41	48	
Other	0	3	2	
Intubation History (%)	10	7	9	.64
Asthma duration >10 years (%)	76	79	78	.75
Steroids administered in ER (%)	59	62	60	.79
Peak Flow Rate (L/min)	220 (165-315)	260 (190-360)	250 (180-343)	.37
Symptom score	8 (7-11)	9 (7-11)	9 (7-11)	.95

Table 1b

Outcome*	LiteAir (n=29)	Nebulizer (n=29)	p
Peak Flow Rate Increase (L/min)	120 (75, 180)	120 (80, 155)	.56
Symptom Severity Decrease	7 (5, 9)	7 (4, 9)	.78
Disposition (%)	97%	93%	.55
Home Admitted	3%	7%	
Length of Stay in ER (hours)	2 (1.5, 3)	2 (1, 2.5)	.78
Received Rescue Treatments (%)	24 %	21 %	.75

Table 2

	Lite Air	Nebulizer	p
Cost of Delivery System*	\$ 2.95	\$ 1.50	—
Cost of Medications	\$ 0.34 (0.26-0.51)	\$ 0.38 (0.19- .48)	.37
Cost of Respiratory Therapist	\$ 6.82 (6.82-6.82)	\$16.38 (8.19-20.48)	<.001
Total cost	\$10.11 (10.03-10.28)	\$ 18.26 (9.88-22.45)	<.001

Results

Table 3

We screened 75 patients who presented to our adult emergency department for an asthma exacerbation. Of 75 patients screened, 5 did not satisfy eligibility criteria and 10 did not consent for participation into the research. The remaining 60 patients were randomized into two study groups, 30 in each. One patient from each group was not included in the outcome analysis because one patient withdrew consent and the other signed out against medical advice, leaving 29 per group for the study sample. Entry characteristics for the two randomized treatment groups were similar in terms of race, intubation history, asthma duration >10 years, steroid administration, peak flow rate and symptom severity score (Table 1). The LiteAir group had a higher percentage of female patients and was somewhat at a higher mean age.

Disposition (discharged home or admitted to hospital) was similar between the groups (p = 0.55). One patient in the LiteAir group and two in the nebulizer group were admitted to the hospital (3% vs. 7%), while 28 patients of the LiteAir and 27 of the nebulizer group (97% vs. 93%) were discharged home at the completion of the study (Table 2).

Medians (interquartile range) for increase in peak flow from entry to disposition were similar for the two groups with 120 (75-180) L/min for the LiteAir and 120 (80-155) L/min for the nebulizer group (p=0.56) (Table 2). Symptom severity scores were also similar (p=0.78). At least one rescue bronchodilator treatment was necessary for 24% of the LiteAir group compared to 21 % of the nebulizer group (p=0.75). The median length of ER stay was 2 hours for both groups with an interquartile range of 1.5-3.0 hours for the LiteAir group and an interquartile range of 1-2.5 hours for the nebulizer group (p=0.78). Neither gender nor race was significantly associated with any outcome (p > 0.34 for all). With 29 participants per group we had > 95% power to detect if the nebulizer was >50% better than LiteAir for either increase in peak flow or decrease in symptom severity score.

The cost analysis for the two groups is summarized in Table 3. Payroll costs (including fringe) for a respiratory therapist (RT) in our institution is on average \$40.94 per hour. The RT needs about ten minutes to instruct and demonstrate the use of LiteAir spacer to a patient, just once for the entire ER stay. For the nebulizer group, it requires on an average approximately 12 minutes per treatment. Thus, the cost for the RT time represents the biggest difference in costs between the two groups, with a constant \$6.82 per patient in the LiteAir group and a median (interquartile range) of \$16.38 (8.19-20.48) for the nebulizer group (p<.001). There is a one-time cost per patient for the delivery system of \$2.95 for LiteAir Spacer and \$1.50 for nebulizer. Per treatment costs of the medication are \$0.17 and \$0.19 for LiteAir and nebulizer respectively. Total costs were significantly lower (p < .001) for the LiteAir group with median (IQR) \$10.11 (10.03-10.28) compared to \$18.26 (9.88-22.45) for the nebulizer group.

Conclusion

We found that in a busy, municipal hospital ER, bronchodilator therapy for adults with acute exacerbation of asthma can be administered just as efficaciously using the LiteAir device as with a conventional nebulizer. Additionally, it may result in savings in time and effort invested by the respiratory therapist and consequently a savings in total cost for treatment.