Short Communication

Evaluating the Use of the Aerobika Vibratory Positive expiratory Pressure Device in Children with Moderately Severe asthma Exacerations

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Abstract

Acute asthma flares are associated with bronchospasm, inflammation and mucus plugging. We previously showed the benefits of a breath-actuated nebulizer (BAN) to deliver albuterol more effectively than other aerosol devices in the Pediatric Emergency Department (PED). Little has been published on interventions to improve mucus plugs which cause ventilation-perfusion defects, hypoxemia and limit aerosol deposition. A new oscillatory positive expiratory pressure (PEP) device, the Aerobika was constructed to fit directly on the BAN device, so a patient can do airway clearance while receiving their aerosol treatments. This preliminary study was designed to explore the use of Aerobika in patients presenting to the PED for asthma exacerbations, specifically its tolerance and safety.

A convenience sample of patients, aged 5-16 yrs, presenting with acute asthma exacerbations from October 2014-June 2015 was selected and compared to similar patients treated with the BAN alone in our previous study from 2008. Patients with moderate asthma severity/clinical asthma score (CAS) 4-6/10 were compared. There were 21 patients in the Aerobika (A) group and 39 patients in the BAN (B) group. The average initial CAS was identical between groups (3.7 ± 0.2). The average improvement in CAS after the 1st treatment was similar (-2.0 ± 0.4 [A] vs -2.2 ± 0.2 [B]). There were no adverse events such as pneumothorax or severe respiratory distress in the A patients.

The Aerobika is well-tolerated by children with acute asthma flares and did not lead to adverse events. Parents felt the device promoted more effective cough than their children experienced previously. We strongly feel that patient and parent satisfaction with use of the device will play a positive role in patient compliance for future studies.

INTRODUCTION

Acute asthma exacerbations are thought to be caused by airflow obstruction resulting from airway inflammation, bronchospasm, and mucus plugging [1]. Current standard of treatment of these exacerbations includes the administration by aerosol of short-acting beta agonist medications [2]. We previously showed the benefits of a breath actuated nebulizer (BAN) to administer this medication more effectively than other aerosol devices in the Pediatric Emergency Department (PED) [3]. Little has been published on interventions to improve mucus plugging during acute asthma exacerbations. Mucus plugging causes ventilation-perfusion defects and resultant hypoxemia [4]. Due to mucus plugging, aerosol deposition can be diminished, thus limiting bronchodilation [5]. Cough is the primary mechanism for clearance of mucus; therefore, in increasing
productive cough during treatments is very likely to lead to resolution of symptoms more effectively [6]. Vibratory positive expiratory pressure (PEP) devices have been studied extensively and compared to other forms of physiotherapy in patients with cystic fibrosis [7]. However, little has been published on ways to decrease mucus plugging in patients with acute flares of asthma.

A new vibratory positive expiratory airway pressure device (AerobiKa) has been developed by the Monaghan Corp. to improve airway mucus clearance in patients with cystic fibrosis (CF). It has been constructed to fit directly on the BAN device. Hence, a patient can do vibratory airway clearance simultaneously, while receiving an aerosol treatment through the BAN device. The AerobiKa has been designed to create bursts of oscillating expiratory resistance to mobilize mucus in the lower airways to improve mucous removal by coughing. Such devices have been shown to improve lung hygiene and prevent infections [7]. In pediatric patients with cystic fibrosis the AerobiKa has been shown to also improve patient compliance and acceptance of respiratory therapies. It has also been shown to be at least as effective as manual chest physiotherapy [8]. However, this device has not been studied in patients with asthma. Our goal with this preliminary study was to explore the use of AerobiKa in patients presenting to the PED for asthma exacerbations, specifically its tolerance and safety.

MATERIAL AND METHODS

This is a retrospective, non-randomized, non blinded convenience sample of patients, aged 516 years, presenting with acute asthma exacerbations over an 8 month period (October 2014-June 2015). An initial clinical asthma score (CAS) was assigned to each child with wheezing. The CAS has been developed by a multidisciplinary Children’s Hospital Pediatric Asthma Committee and is utilized in both the PED and the entire MUSC Children’s Hospital. Patients with a moderate CAS were included in the study. These patients were compared to similar patients treated with the BAN alone in our previous study from 2008 [3]. All patients during both study periods who presented with first time wheezing or wheezing with known diagnosis of reactive airway disease or asthma were included in the data collection. Patients with cystic fibrosis, broncho pulmonary dysplasia, immunodeficiency disorders (including sickle cell disease), and cardiac disease and suspected foreign body aspiration were excluded. Children 5 years old or younger were excluded due to tolerance of the BAN and AerobiKa devices. In agreement with the PED’s attending physician, on the days when a BAN & AerobiKa-trained RT was covering the PED, patients who met the inclusion criteria received these therapies. These patients made up the AerobiKa intervention group (A). The patients who received only the BAN device during the previous study in 2008 were the BAN intervention group (B). The albuterol dosing for the AerobiKa group was based on a combination of the initial CAS and clinical judgment. During the previous study, the intervention group dosing was as follows: 2.5 mg for children weighing 5 kg to 10 kg, 5 mg for children weighing 10 kg to 20 kg, and 7.5 mg for children weighing more than 20 kg. In addition to albuterol, it is standard practice in our PED to combine ipratropium bromide as an adjunct to albuterol, dosed at 250 to 500 µg per treatment. Hence, all patients received ipratropium bromide in addition to albuterol with each treatment in both groups.

Statistical analysis

To determine the effectiveness of the AerobiKa device, the following primary outcome measures were compared between the AerobiKa and BAN group in patients with moderate clinical severity: mean initial CAS, mean change in CAS after the first albuterol treatment, percent of patients requiring admission per group and adverse outcomes including pneumothorax and severe respiratory distress. The descriptive statistics included means, standard deviations (SD), Standard Error of the Mean (SEM), ranges and p values. A p value of <.05 with the Student’s t-test was considered statistically significant. The MUSC institutional review board approved this study.

RESULTS

Patients with moderate asthma severity/CAS 46/10 were compared. (No patients classed as severe were evaluated and treated during this study.) There were 21 patients in the AerobiKa (A) group and 39 patients in the BAN (B) group. Group A patients were older (mean + SEM) vs Group B – 8.2 + 0.8 vs 5.3 + 0.7 years (p <.05), but gender distribution was similar (67% vs 69% males).

The average initial CAS was identical between groups: mean 3.7 ± 0.2. The average improvement in CAS after the 1st treatment was similar: Group A vs B: -2.0 ± 0.4 vs -2.2 + 0.2 (NS). The total albuterol doses (mean +/- SEM) were 18.3 +/- 2.6 mg for Group A and 11.9 +/- 1.3 mg for Group B patients (< .01).

Seven patients from Group A (33%) were admitted as compared to 5 patients (13%) from Group B. There were no adverse events such as pneumothorax or severe respiratory distress in patients who received AerobiKa or the BAN alone.

DISCUSSION

Our study showed that the AerobiKa Vibratory Positive Expiratory Pressure device was well-tolerated by patients without occurrence of adverse events along with similar improvement in clinical asthma scores between the two intervention groups. Although not directly measured in our study, the use of the AerobiKa device in the management of asthma in the PED appears to have a positive effect on parent & patient satisfaction. Parents specifically reported satisfaction with the AerobiKa device and commented on the ease of use for their child (a “WOW” effect). Some parents commented that they brought the device home and have continued to use it for benefit for future asthma exacerbations in the outpatient setting (even mild flares, helping to avoid PED visits). Additionally, parents felt that the device was easy to learn for the patient to self-administer and that it did not interfere with daily activities.

Although our study did not show a reduced admission rate or amount of albuterol used, it is important to note that the comparison group was significantly remote in time. Patients in Group A appear to have been more ill upon assessment given admission rate and albuterol dosage. Groups A & B were not matched for season or controller inhaler use which could have accounted for the difference in admission rate.
The age distribution difference in the two groups may have contributed to the increased need for admission in the AerobiKa group, as older patients may be prone to having more significant airway inflammation. Our study could not control for the difference in age between the two groups because they were not matched or paired at time of data collection. We also were not able to document the duration of time these patients had asthma. The results of our study suggest that the AerobiKa device is safe and well tolerated. We did not happen to have any severe (CAS 7-10) patients, however, with our excellent safety and patient tolerance, we would suggest that future research on the AerobiKa device is warranted and should have specific focus on the more severely-ill asthmatic patients with significant hypoxemia, atelectasis, a productive cough and respiratory distress.

Our study was limited by physician and RT practice in the ED as well as knowledge of the AerobiKa device. Only specific RTs were in serviced on the use of this device. It is also possible that the difference in physician practice over the two data collections may have affected the hospitalization rate as there is currently no standard practice for admission. Validity of these results is limited by the study using a convenience sample, making selection bias likely. As this study was conducted at a single site, the external validity of the results is limited.

**CONCLUSION**

The use of the AerobiKa device is well tolerated by patients in the PED. It is an easy to use, portable device which allows simultaneous provision of vibratory PEP therapy without interrupting bronchodilator aerosol delivery. When used at home for patients with CF, there is little interruption to daily living [7]. While our study did not demonstrate statistical significance in terms of improved CAS or reduced hospitalization rate, the comparison group being collected at a different time is likely to have had an impact on our results. At this time, more studies are warranted, specifically with more severe exacerbations. We strongly feel that patient and parent satisfaction with use of the device will play a positive role in patient compliance for future studies.

**REFERENCES**