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Brief Reports

BENEFICIAL EFFECTS OF WARMED HUMIDIFIED OXYGEN COMBINED WITH NEBULIZED ALBUTEROL AND IPRATROPIUM IN PEDIATRIC PATIENTS WITH ACUTE EXACERBATION OF ASTHMA IN WINTER MONTHS

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□ **Abstract—Background: The objective of this study was to determine whether a combination of nebulized albuterol and ipratropium with warmed humidified oxygen would be more beneficial when compared to the same combination with humidified oxygen at room temperature. Albuterol alone was tested in the same settings. Methods: All patients between 6 and 17 years of age who presented to a pediatric emergency department in the winter months with acute exacerbation of bronchial asthma were given a combination of nebulized albuterol and ipratropium with warmed or room temperature humidified oxygen. Peak flow was measured before and after the treatment. Results: Sixty patients were enrolled in the study, with 15 subjects in each group. The mean increase in peak flow in the albuterol-ipratropium with warm humidified oxygen group was 52.6, and in the albuterol-ipratropium with humidified oxygen at room temperature group, it was 26.2. The results of the albuterol with warmed humidified oxygen and with humidified oxygen at room temperature groups were 20.6 and 34.3, respectively. The differences between the groups were statistically significant. Conclusion: Our study shows that warmed humidified oxygen given along with the combination of nebulized albuterol and ipratropium is more beneficial for pediatric patients having an acute exacerbation of bronchial asthma in the winter months when compared to nebulized albuterol alone with warmed humidified oxygen, nebulized albuterol alone with room temperature humidified oxygen, or a combination of nebulized albuterol and ipratropium with room temperature humidified oxygen.**

□ **Keywords—pediatric asthma; warm humidified oxygen; bronchodilators**

INTRODUCTION

Guidelines for the treatment of patients with acute asthma have recommended the use of inhaled, short-acting beta-agonists (1). Other treatment modalities include the use of nebulized beta-agonists with nebulized ipratropium bromide (2).

Carbone and Marini showed an increase in FEV1 (forced expiratory volume in the first second) in warm air inhalation compared to room temperature air inhalation in adult asthma patients (3). No such study has been done, to our knowledge, in pediatric patients with acute exacerbation of bronchial asthma.

We hypothesized that the use of a combination of nebulized albuterol and ipratropium with warmed (40°C) humidified oxygen will increase the peak flow (a functional measure used in asthma patients) in children who present to the pediatric Emergency Department (ED) with an acute exacerbation of asthma during the winter months when compared to the following: 1) nebulized albuterol alone with room temperature humidified oxy-

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gen, 2) nebulized albuterol alone with warmed (40°C) humidified oxygen, or 3) the combination of nebulized albuterol and ipratropium with room temperature humidified oxygen.

This study was conducted in a pediatric ED in patients who presented with acute asthma exacerbation during the winter months.

MATERIALS AND METHODS

The study is an Institutional Review Board (IRB)-approved, prospective, randomized, non-blinded study. Patients meeting the inclusion criteria were enrolled in the study during the winter months. Patients who fell into the exclusion criteria category were excluded from the study.

Inclusion Criteria

1. Patients between 6 and 17 years of age who presented to the pediatric ED during the winter months with acute exacerbation of bronchial asthma as assessed with the Asthma Severity Score (3).
2. Patients with upper respiratory infection and pneumonia were included in the study if there was no documented fever in the ED (i.e., no temperature of 38°C [100.4°F] and above).
3. Patients' parents signed the IRB-approved informed consent form.

Exclusion Criteria

1. Patients unable to perform the peak flow such as those with certain physical or mental conditions.
2. Intubated or tracheostomized patients.
3. Patients with temperature above 38°C (100.4°F) tympanic.
4. Patients in congestive heart failure.
5. Parents or adolescents who refused to sign the informed consent form.

Patients were randomized into four groups: Groups A, B, C, and D.

Group A: Received nebulized albuterol and 6 L room temperature humidified oxygen.

Group B: Received nebulized albuterol and 6 L warmed humidified oxygen.

Group C: Received a combination of nebulized albuterol and ipratropium with 6 L warmed humidified oxygen.

Group D: Received a combination of nebulized albuterol and ipratropium with 6 L room temperature humidified oxygen.

Patients were enrolled after clinical evaluation, oxygen saturation monitoring, and measurement of peak flow. Patients in Groups A and B received a 1-unit dose of albuterol (2.5 mg in 3 mL normal saline), whereas patients in Groups C and D received a combination of a 1-unit dose of albuterol (2.5 mg in 3 mL) and a 1-unit dose of ipratropium (0.5 mg in 2.5 mL).

Patients in all four groups received oxygen at 6 L. Groups A and D received room temperature humidified oxygen, whereas Groups B and C received warmed humidified oxygen (40°C) using a setup developed by the primary author. The handheld nebulizer was used for administering the 3 mL of either warmed or room temperature saline. This was connected via T-tube to another nebulizer setup where either albuterol or a combination of albuterol and ipratropium were added. These two nebulizer setups were connected to holes in the face mask and attached to the face as shown in Figure 1.

The warming of normal saline was done by heating the bottle containing normal saline in a microwave at the highest setting for 2 min. Sterile normal saline at room temperature was added to this heated normal saline in a sterile cup (10 mL) to titrate the temperature to 40°C. Then 3 mL of this warmed normal saline was added to the second nebulizer setup. Oxygen was administered through the second nebulizer setup, and the patient breathed through the face mask (Figure 1). After treatment, patients were evaluated for peak flow. The difference in the initial and the post-treatment peak flow was the primary outcome measure.

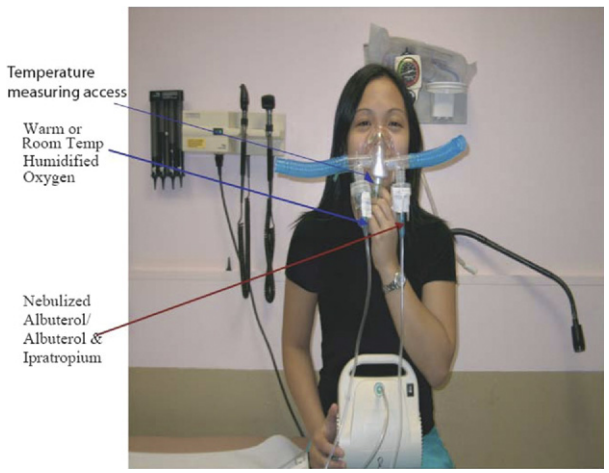

Figure 1. A photograph showing the setup for applying warm humidified oxygen and medications.