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Paediatrics

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THE EFFECT OF NEBULIZED SALBUTAMOL ON SERUM POTASSIUM AND BLOOD SUGAR LEVEL OF ASTHMATIC PATIENTS OF PEDIATRICS AGE GROUP

Dr. Hanuman Prasad PG Resident (MD), Department Of Pediatrics, Jhalawar Medical College, Jhalawar.

Dr. Aditi Makkar* Pg Resident (md), Department Of Pediatrics, Jhalawar Medical College, Jhalawar. *Corresponding Author

ABSTRACT

BACKGROUND- The objective of this study was to evaluate the effect of nebulized salbutamol used in the management of patients with asthma who have normal serum potassium and blood glucose levels in the emergency department after 30 and 60 minutes of administration and to find out if these results are of clinical importance that should be taken into consideration when treating patients especially those with abnormal glucose hemostasis or electrolyte disturbance.

METHODS- Hospital based prospective study conducted on 30 children at Department of Pediatrics, Jhalawar Medical College and Hospital, Jhalawar (Rajasthan).

RESULTS- The potassium mean was significantly decreased after 1 hour of nebulizer administration. The random blood sugar mean was significantly increased after 1 hour of nebulizer administration ($p<0.001$).

Conclusions- The nebulizer applying salbutamol has a profound effect in lowering the Potassium level and increasing blood glucose level after 60 minutes of administration.

INTRODUCTION

Nebulizers are inhalation devices that use oxygen, compressed air or ultrasonic power to break up solutions or suspensions of medication into droplets for inhalation. The aerosol is administered by a mask or mouthpiece. However, nebulizers are more expensive than pressurized metered dose inhalers, require a power source and need regular maintenance.

Adrenergic stimulation of cardiac β2 Agonist Receptors (β2ARs) modulates the heart rate and contractility of the heart. In skeletal muscles, the effect of β2ARs stimulation is through a G-protein activation of adenyl cyclase which leads to elevation of cAMP and subsequent activation of protein kinase (PKA). PKA catalyzes the phosphorylation of a number of receptors within the myocytes, including ryanodine receptors and troponin, leading to increased contractility. Membrane channels and binding proteins are phosphorylated by PKA in pacemaker cells which leads to changes in the cardiac action potential through increased Ca^{2+} cycling.

Activation of glycogen phosphorylase, phosphofructokinase, pyruvate dehydrogenase and hormone-sensitive lipase increases substrate utilization in skeletal muscles. Furthermore, β2AR stimulation of the Na+ /K+ -ATPase pump increases intracellular concentrations of potassium and hyperpolarization of the cellular membrane. The activation of this pump consumes ATP, leading to ADP production that further drives glycolysis, resulting in increased lactate production (Andersson et al., 2012; Kalsen et al., 2014; Levy et al., 2008). β2AR agonists are known to increase membrane Na+ /K+ ATPase activity, thereby increasing intracellular [K+], decreasing intracellular [Na+], and maintaining membrane excitability and hyperpolarizing the sarcolemma .

The decrease in serum potassium is dose-related and potency-related, with some β2AR agonists having a more profound hypokalemic effect than other β2AR agonists, with fenoterol having a more profound hypokalemic effect than albuterol or formoterol or terbutaline. Also the β2AR agonists increase glycogenolysis and hence increase plasma glucose.

This is of minor clinical importance, except in diabetic patients, whose disease is likely to be aggravated by the use of systemic corticosteroids in situations of severe asthma. The effect on glucose also shows tolerance with repeated use.

MATERIAL AND METHODS

Study design: Hospital based prospective study. Study place: Dept. of Pediatrics, Jhalawar Medical College and Hospital, Jhalawar

Study Population:
All the children with mild exacerbation of asthma who needed two doses of 2.5 mg nebulized salbutamol, 10 minutes apart for the relief of their symptoms will be include.

Sample size: Sample size of 30 patients required at 80% study power and alpha error 5%. Omar Farooq Nafea Al-Azzawi et al found that the potassium mean was significantly decreased after 1 hour of nebulizer administration (4.57±0.68 Vs 4.4±0.68).

Sampling Method: Simple random sampling

Inclusion Criteria:
All the children with mild exacerbation of asthma who needed two doses of 2.5 mg nebulized salbutamol, 10 minutes apart for the relief of their symptoms will be include.

EXCLUSION CRITERIA:

- Patients who used 2AR less than four hours before admission.
- Recent cardiac event (MI, angina or cardiac arrythmia).
- Diabetic patients or abnormally high blood glucose at base line level.
- Abnormally high serum potassium at base line.
- Patients with severe dyspnea and/or respiratory failure.
- Patients with renal failure.
- Patients using potassium sparing diuretics e.g. Aldactone and antihypertensive drugs e.g. B.blocker, ACE inhibitor, Angiotensin II.

ETHICAL ISSUES:
A written, informed consent was obtained from parents. Clearance from Departmental Ethics Committee was taken prior to the start of the study.

Approval of Ethical Committee:
Approval of Institutional Ethics Committee was obtained from Letter S.No. 05/65/Dated09-10-2020.

DATA COLLECTION:
A 5ml sample of venous blood will be taken and sent to the Laboratory to evaluate the serum potassium and random

blood sugar levels (Baseline level).

Then the selected patients will be treated with 2.5mg nebulized Salbutamol, while the patient will be sitting in upright position and the mask of the nebulizer was held on the nose.

After 20 minutes the second dose of 2.5mg nebulized Salbutamol was given through the nebulizer in the same way for the patients who needed this 2nd dose and so the total dose used will be 5mg only, as we only recruited mildly dyspneic patients to decrease the chance of using other agents that may affect potassium and glucose level.

Thirty minutes after nebulizer cessation, 5 ml of venous blood was drawn and sent for the Laboratory to re-check the Potassium and random blood sugar levels (30 minutes level). One hour later, after nebulizer cessation, another 5 ml of venous blood will be drawn and sent for the Laboratory to re-check the Potassium and random blood sugar levels (One hour level).

DATA ANALYSIS:

All data were analyzed on EPI-info statistical software. Qualitative data were expressed in the form of proportion. Quantitative data were expressed in mean ± SD Qualitative data were compared by Chi square test Unpaired t test were use to infer the difference in means. For significance, following at the level of "p" value was taken-

P > 0.05 = Not significant
P = 0.05 = Just significant
P < 0.05 = Significant
P < 0.001 = Highly significant.

RESULTS

Table 1. Socio-demographic variable

Potassium

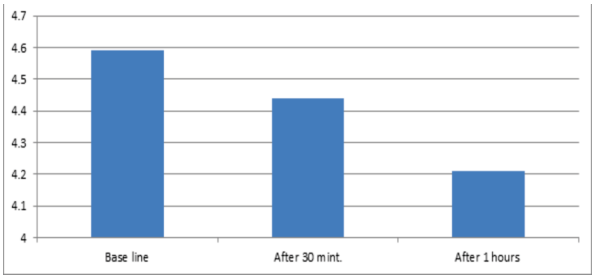
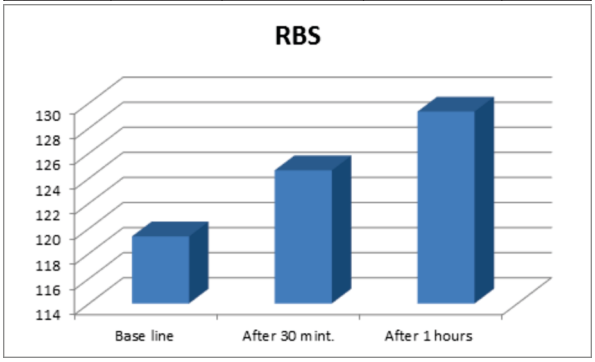


Table 2. Distribution of potassium and blood sugar according to three measurements

Variable	Base line	After 30 mint.	After 1 hours	p-value
Potassium	4.59±0.03	4.44±0.02	4.21±0.02	0.01
RBS	119.36±18.36	124.63±17.56	129.32±18.01	0.01



The potassium mean was significantly decreased after 1 hour of nebulizer administration. No significant changes in potassium mean were observed between baseline measurement and after 30 minutes measurement, but the potassium mean was not significantly changed between 30 minute measurement and 1 hour measurement. The random blood sugar mean was significantly increased after 1 hour of nebulizer administration. Mean RBS measurement at baseline was not significantly different from RBS measurement after 30 minutes. Similarly, RBS mean was not significantly changed between 30 minute measurement and 1 hour measurement.

Table 3. Distribution of potassium and RBS means according to three measurements for steroids history groups

Variable		Base line	After 30 mint.	After 1 hours	p-value
Potassium	Positive steroid	4.62±0.03	4.51±0.02	4.32±0.02	0.01
	Negative steroid	4.44±0.03	4.32±0.02	4.18±0.02	0.01
RBS	Positive steroid	118.36±18.09	121.36±17.11	129.36±18.13	0.01
	Negative steroid	120.32±18.01	125.36±17.02	132.09±17.69	0.01

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DISCUSSION

For acute asthma, repeated doses of nebulized β2-agonists and to a lesser extent, IV aminophylline, is the mainstay therapies which are used to relieve bronchospasms and airway obstruction. Children suffering from mild symptoms are generally treated with oral β2- agonists in the form of syrups. Only few numbers of asthmatic children had severe symptoms which required initial nebulization and steroids, followed by oral medication. It was observed in the present study, that asthmatic children receiving β2 agonists in form of the salbutamol syrup (Group2) showed a highly significant decrease in the potassium levels, as compared to (Group 2). A statistically highly significant decrease in the serum potassium levels was observed following the use of β2 agonists; the clinical significance of which is not known and warranted further study, as 5 study subjects were not presented for the follow up. This limitation can be overcome by undertaking further studies. Earlier studies also found decreased serum potassium levels to be the earliest form of electrolyte disturbance in asthma, and it was related to the use of β2-agonists. Mildly decreased serum potassium levels have also been reported in untreated patients with severe asthma due to the stress of the asthmatic attacks.

There were no significant differences in the serum sodium levels in the two groups. This may be due to the fact that a maximum number of asthmatic children were having mild symptoms. In the present study, the decrease in the serum potassium levels in the group 2 asthmatic children was within normal limits, but the decrease was highly significant as compared to that in the group 1 asthmatic children. The decreased serum potassium levels may occur due to the active inhibition of potassium secretion in the cortical collecting tubule, which is possibly caused by the stimulation of the membrane sodium potassium-dependent adenosine triphosphatase that results in the hyperpolarization of the cellular membrane potential. So, the use of such therapies will increase the derangement of the existing abnormal electrolyte levels. Consequently, this may pose potential cardiac and respiratory hazards in the form of myocardial depression, ventricular arrhythmia and respiratory muscle

fatigue, which may consequently increase the incidence of fatal asthma. It is likely that these complications may occur especially in the presence of hypoxia or acidosis, or in asthmatic patients with preexisting cardiovascular disease. Therefore, the measurement of the serum electrolyte levels before and during the management of asthma with bronchodilators may reduce such risks, if they are corrected.

CONCLUSION

The treatment of asthma with oral β2- agonists may lead to hypokalaemia. The inappropriate and continuous use of such drugs may also cause the hypokalaemic paralysis of the respiratory muscles. β2 agonist administration by a dry powder inhaler or by nebulization 3 times per day can be considered worthwhile, since the dose of such an administration is very less. However, this is not always feasible in small children and if the asthmatic attack is acute, repeated doses of nebulized β2 agonists are essential. Thus, the monitoring of the electrolytes with immediate correction may be warranted in asthmatic children to decrease the mortality

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