

The effect of oral salbutamol on the metabolism of electrolytes in asthmatic children

Nagdeote AN, Pawade YR

ABSTRACT

Background: Experimental evidence suggests that sodium and potassium may affect the responsiveness of airways. In asthma, the electrolyte metabolism is also affected during the course of anti-asthmatic therapy by using β 2-agonist drugs like salbutamol.

Objective: To determine whether the therapy for the treatment of asthma affects the sodium and potassium metabolism.

Method: 50 children between 2 to 12 years of age with asthmatic attack were selected for the study. 18 children had a severe attack of asthma. Blood samples were collected from them and the therapy for the treatment of asthma was started, which included β 2-agonists like salbutamol. Children with severe asthmatic attack were treated with nebulized salbutamol along with corticosteroids. After 15 days, the asthmatic children were

again called for a follow up study and their blood samples were collected. The serum levels of sodium and potassium were measured on an Ion Selective Electrode (ISE) based electrolyte analyzer.

Results: The results showed a significant decrease in the serum potassium levels in children receiving the β 2-agonists. The decrease in the potassium levels was irrespective of the severity of the asthmatic attack in both the sexes. There was no significant change in the serum sodium levels.

Conclusion: The use of β 2-agonists may lead to hypokalaemia. The inappropriate and continuous use of such drugs may also cause hypokalaemic paralysis of the respiratory muscles. The monitoring of the electrolytes may be warranted in asthmatic children to decrease the mortality.

Key Words : Asthma, β 2-agonists, salbutamol, hypokalaemia

INTRODUCTION

It has been suggested that sodium and potassium levels influence the responsiveness of the airway smooth muscles [1] [2]. The interest in the electrolyte disturbance in asthma patients has so far been focused on the serum potassium levels which are especially linked to the therapy with β 2-agonists [3] [4] [5]. Tremors, tachycardia, palpitations, and anxiety are the well-known side effects of such treatments [6]. The mortality rate in patients with asthma is still rising and has been partly attributed to the adverse effects of the β 2-agonists which are administered for asthma management [7].

AIMS AND OBJECTIVES

In view of the above findings, it was thought worthwhile to examine the alteration, if any, in the blood levels of certain electrolytes like sodium and potassium in childhood bronchial asthma.

MATERIAL AND METHODS

The present study was carried out in the Department of Biochemistry, Government Medical College, Nagpur, over a period of one and a half years. The study protocol was approved by the institutional ethical committee. 50 (26 males and 24 females) children between 2 to 12 years of age with asthmatic attack, who attended the pediatric OPD were selected for the study. 32 asthmatic children had mild symptoms, while 18 children had a severe attack of asthma with no medical emergency. Venous blood samples were collected from them and the therapy for treatment of asthma was started, which included β 2-agonists like 2 mg tds salbutamol in the form of syrups for 15 days. Children with a severe attack of asthma were treated

with nebulized salbutamol along with steroids until the severe attack was resolved. Thereafter, a similar treatment was given, as was given to mild asthmatics. After 15 days, the asthmatic children were again called for follow up study, out of which only 45 (26 males and 19 females) children could come for the clinical check up. Blood samples were again collected and the serum sodium and potassium levels were measured by using an ISE based electrolyte analyzer, Easylyte, from Transasia [8]. Thus, the asthmatic children were divided into two groups. Group 1 included the asthmatic children whose serum electrolytes were measured before receiving the treatment and group 2 included the asthmatic children whose serum electrolytes were measured after receiving the treatment. All the statistical comparisons were done by using the Paired Student's 't' test with the help of the SPSS Statistical Software v15.0.

OBSERVATIONS

In the present study, the results were expressed as mean \pm SD in a tabular form. A p value 0.05 was considered as statistically significant.

Serum Electrolytes	Group 1(50)	Group 2 (45)
Serum Sodium (mmol/L)	138 \pm 3.4	139 \pm 3.8
Serum Potassium (mmol/L)	4.13 \pm 0.46	3.6 \pm 0.42*

[Table/Fig1] Serum sodium and potassium levels in asthmatic children before treatment (Group 1) and after treatment (Group 2) *P < 0.001

The number in the parenthesis indicates the number of individuals who were incorporated in the study.

Serum electrolyte	Male		Female	
	Group 1(26)	Group 2(26)	Group 1(24)	Group 2(19)
Serum sodium(mmol/L)	4.13 ± 0.46	3.6 ± 0.42*	137 ± 3.6	139 ± 3.8
Serum potassium(mmol/L)	4.11 ± 0.52	3.6 ± 0.27*	4.13 ± 0.35	3.6 ± 0.27*

[Table/Fig2] The serum sodium and potassium levels in asthmatic children before treatment (Group 1) and after treatment (Group 2) according to the sex pattern
*P < 0.001 The number in the parenthesis indicates the number of individuals who were incorporated in the study

Serum electrolyte	Sever Asthmatics		Mild Asthmatics	
	Group 1(18)	Group 2(15)	Group 1(32)	Group 2(30)
Serum sodium(mmol/L)	139 ± 3.6	139 ± 3.7	137 ± 3.5	139 ± 3.5
Serum potassium(mmol/L)	4.11 ± 0.32	3.6 ± 0.50*	4.13 ± 0.50	3.6 ± 0.33*

[Table/Fig3] The serum sodium and potassium levels in asthmatic children before treatment (Group 1) and after treatment (Group 2) according to the severity of the asthmatic attack
*P < 0.001

[Table/fig3] depicts that significant decrease in the serum potassium levels in asthmatic children who received the β_2 agonists irrespective of the severity of the asthmatic symptoms.

DISCUSSION

For acute asthma, repeated doses of nebulized β_2 -agonists and to a lesser extent, IV aminophylline, is the mainstay therapies which are used to relieve bronchospasms and airway obstruction [9]. Children suffering from mild symptoms are generally treated with oral β_2 -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 β_2 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 β_2 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 β_2 -agonists [3][4] [5]. Mildly decreased serum potassium levels have also been reported in untreated patients with severe asthma due to the stress of the asthmatic attacks [10].

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 [11]. 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 [12] and respiratory muscle fatigue, which may consequently increase the incidence of fatal asthma [13]. It is likely that these complications may occur especially in the presence of hypoxia or acidosis, or in asthmatic patients with preexisting cardiovascular disease [14]. 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 β_2 - agonists may lead to hypokalaemia. The inappropriate and continuous use of such drugs may also cause the hypokalaemic paralysis of the respiratory muscles. β_2 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 β_2 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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AUTHOR:

1. NAGDEOTE AN M.B.B.S., M.D. (Biochemistry), Associate Professor, Dept. of Biochemistry, ESIC Model Hospital, PGIMSR & ODC, Andheri, (E), Mumbai (M.S.) – 400 093
2. PAWADE YR M.B.B.S., M.D. (Biochemistry), Senior Resident (in Biochemistry), Dept. of Biochemistry, ESIC Model Hospital, PGIMSR & ODC, Andheri (E), Mumbai (M.S.) – 400 093

NAME OF DEPARTMENT(S)/INSTITUTION(S) TO WHICH THE WORK IS ATTRIBUTED:

Government Medical College, Nagpur.

NAME, ADDRESS, TELEPHONE, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr A N Nagdeote
Associate Professor in Biochemistry
ESI Post Graduate Institute of Medical Sciences and Research,
Andheri east, Mumbai. 400093
E-mail: abhayanuaru@rediffmail.com

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