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Research Article

Effect of repeated salbutamol nebulization on serum potassium level in children with acute wheeze at tertiary health care center in Birgunj, Nepal

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Abstract



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Background: Nebulization Salbutamol has important role in the treatment of Acute wheeze despite of reported electrolyte imbalance so this study was conducted to know the changes in serum potassium level post Nebulization.

Methods: A Cross-sectional observational study was conducted among 67 children aged 12-60 months presenting with acute wheeze at tertiary health care center. Baseline clinical parameters heart rate, respiratory rate, SpO₂ along with serum potassium level was compared before and post repeated Salbutamol Nebulization.

Results: The mean age of the study population was 35.95 months. The mean number of repeated Salbutamol Nebulization was 4.9 over mean time of 151 mins. There was significant increase in heart rate, decrease in respiratory rate and SpO₂ post Salbutamol Nebulization. The Mean \pm SD serum potassium concentration before and after Post Nebulization was 4.44 \pm 0.85 mEq/L and 4.01 \pm 0.97 respectively and it was statistically significant

(P<0.05, paired t-test). A fall in serum potassium was seen in 40 patients (59.70%).

Conclusion: Nebulization Salbutamol causes changes in serum potassium level so it should be monitored.

Keywords: Acute wheeze, Heart rate, Nebulization Salbutamol, Respiratory rate, SpO₂, Serum potassium.

INTRODUCTION

Acute wheeze is the one of the most common respiratory problems among children and there are wide variations in prevalence of wheeze around the world ¹. The International Study of Wheezing in Infants conducted in different states of Brazil i.e., Curitiba, São Paulo and Belo Horizonte showed at least one episode of wheezing in 45.4%, 46%, and 52% infants respectively and around 1/4th of these infants suffered recurrent episodes of wheezing (three or more) 22.6%, 26.6%, and 28.4% respectively with mean age of onset at 5 months.² A cohort study conducted in Germany exhibited that first wheezing episode was among 29 % of the participants at \leq 3 years of age ,9% each at 3–6 and >6 years of age³. A study conducted in Kathmandu valley reported that about 7.5% of participants replied positively for "ever wheezed" (8.1% in older and 6.4% in young children) and 5.2% reported positively for "current wheeze" (4.2% in younger and 5.8% in older children) 4.

Inhalational β -2- agonist has been the main treatment modality in patients with wheeze and the mode of

delivery can be Metered Dose Inhaler and Nebulization⁵. Salbutamol is a short acting β 2 agonist and it has been widely accepted modality of treatment for termination of acute wheeze whereas Salmeterol, long acting β 2 agonist is used for its maintenance therapy⁶. Hypokalemia, tachycardia, arrhythmia are well-known side effects of oral/parenteral β 2- agonists⁷. Hypo-magnesemia, hypo-phosphatemia, hypo-calcemia have also been reported due to use of β 2- agonists in adults and these electrolyte disturbances can lead to cardiac arrhythmia. Changes in serum electrolyte levels can influence excitability of airway smooth muscles by acting on Na⁺/K⁺ pump ⁸.

Different studies conducted outside Nepal among children and adults have shown that Nebulization with Salbutamol can induce Hypokalemia at conventional dose (1ml diluted with saline)^{9,10} β 2 agonists have been the mainstay of treatment in children with wheeze but there has been paucity of data in our scenario regarding change in serum electrolytes after repeated Salbutamol Nebulization. Therefore, this study was conducted to find out the effect of repeated Salbutamol Nebulization on serum potassium among children presenting with acute

wheeze. If there are any significant changes in serum electrolytes after repeated Salbutamol Nebulization, then routine electrolyte supplementations could be recommended and sudden deaths, cardiac arrhythmia due to electrolyte disturbances could be prevented.

METHODOLOGY

This Cross-sectional observational study was conducted from January 2024 to June 2024 among children (12 months -60months) with acute wheeze at Pediatrics ward of National Medical College and Teaching Hospital (NMCTH), Birgunj, Nepal. The study was cleared by the institutional ethics committee National Medical College and Teaching Hospital, Birgunj, Nepal. A total of 67 children requiring repeated Nebulization (three or more) with Salbutamol within a period of 1–2 h for acute wheeze and those who had Pediatric asthma score (PAS)>3 were enrolled. Exclusion criteria was parents not willing to give consent, children below twelve months and above five years, children having high risk of Hypokalemia such as Acute gastroenteritis, Diabetic ketoacidosis, Cushing syndrome and on drugs such as Diuretics, Systemic Steroids, Theophylline and Systemic β 2-agonists.

A predesigned data collection tool was used to collect the relevant data which consisted of age, gender, PAS, drugs using for treatment and baseline vital parameters (heart rate, respiratory rate, and spO_2). Written informed consent was taken from parents. Under aseptic precautions 3 ml of venous blood was withdrawn in a disposable syringe for baseline potassium level at the time of admission to pediatric ward. Then, the study

population was given repeated Salbutamol Nebulization at a dose of 0.15 mg/kg/Nebulization every half hourly depending on the clinical response (for maximum up to 4 h). Another blood sample for serum potassium level was withdrawn at the end of repeated Nebulization.⁴Number and duration of repeated Nebulization, post-Nebulization vital parameters such as heart rate, respiratory rate, spO_2 was also documented. The collected blood was centrifuged to obtain serum. Serum Potassium was estimated by Ion selective Electrode using Sensa core ST-pro 200 analyzers. The reference range for serum potassium was 3.5-5mEq/L as per the brochure of the analyzer and reagents.

Statistical analysis: The data was entered in Microsoft Excel Sheet 2010 and

Mean \pm standard deviation was calculated using SPSS version 22. The data was analyzed by using "Paired 't' test" for any statistically significant changes in the serum electrolyte levels before and after the treatment. P values less than 0.05 was considered significant.

RESULTS

This study included 67 children aged from 12 to 60 months, presenting with acute wheeze and fulfilling the eligibility criteria. The mean age of the study population was 35.95 months. Out of 67 children, 42(62.68%) were male and 25(37.31%) were females. Table 1 presents baseline clinical parameters of children at the time of admission and post repeated Nebulization with Salbutamol. The mean number of repeated Salbutamol Nebulization was 4.9 over mean time of 151 mins.

Table 1:

Baseline clinical parameters		Post repeated Nebulization with Salbutamol
Heart rate per min	126.81 \pm 17.51	138.38 \pm 18.14
Respiratory rate per min	40.00 \pm 9.51	26.08 \pm 5.71
SpO ₂	87.95 \pm 10.71	95.42 \pm 11.56

Difference in clinical parameters at the onset and post repeated Salbutamol Nebulization is being depicted by Table 2. The Mean \pm SD in Heart rate is -11.57 \pm 5.93. The negative value signifies that there is significant rise in heart rate post Nebulization(p-value<0.05). The Mean \pm

SD in Respiratory rate is 13.92 \pm 6.55 which is also statistically significant as there is decrease in respiratory rate. The Mean \pm SD in SpO₂ is -7.47 \pm 2.64 which is also statistically significant.

Table 2: Difference in clinical parameters at the onset and post repeated Salbutamol Nebulization

Clinical parameters	Mean difference	Standard deviation	95%Confidence Interval of Difference		P -value
			Lower	Upper	
Heart rate per min	-11.57	5.93	-12.99	-10.14	<0.05
Respiratory rate per min	13.92	6.55	12.34	15.49	<0.05
SpO ₂	-7.47	2.64	-8.10	-6.83	<0.05

The Mean \pm SD serum potassium concentration before and after Post Nebulization was 4.44 \pm 0.85 mEq/L and 4.01 \pm 0.97 respectively and it was statistically significant

(P<0.05, paired t-test). A fall in serum potassium was seen in 40 patients (59.70%). However, none of the patients had severe Hypokalemia (serum potassium levels <2.5 mEq/L).

Table 3:

Serum potassium (mEq/L)	Mean \pm SD	p-value
S. Potassium before Nebulization	4.44 \pm 0.85	<0.05
S. Potassium Post Nebulization	4.01 \pm 0.97	

DISCUSSION

This study was conducted to evaluate the changes in serum potassium level among children presenting with acute wheeze requiring repeated Nebulization with Salbutamol. There are limited studies conducted in Nepal as well as other studies have evaluated the effect on serum potassium level after three doses of Nebulization with Salbutamol.¹¹ The mean age of the study population was 35.95 months (around 3 years) which is similar to study conducted by Jain et al where the mean age of study population was 3.1 \pm 3.0 (mean \pm SD) (years)⁵. In our study, most of the children were male as wheezing is more common in males¹³.

In our study, it was observed that after the end of repeated Salbutamol Nebulization, there was a significant increase in mean heart rate which is due to cardiac sympathetic stimulation by Salbutamol which is similar to study done by Singhi et al and Jain et al.^{5,11} However study done by Hung *et al.*, showed no significant increase in heart rate after Salbutamol Nebulization it might be as they had used single dose of Salbutamol Nebulization at a dose of 0.125 mg/kg of . In our study respiratory rate decreased significantly which is in accordance to study done by Hung *et al.*¹² In our study, there was significant fall in serum potassium level which is comparable to study done by Singhi et al where the average fall of serum potassium was 0.2 mEq/L after three repeated Salbutamol Nebulization given after every 30 min interval. A study done by Vittal et al also showed that decrease in serum potassium was 4.053 \pm 0.0485 mEq/L to 3.983 \pm 0.0482 mEq/L ($p < 0.001$) after Salbutamol Nebulization¹⁴.

Serum potassium concentration is affected both by external potassium balance and by internal potassium balance which is further maintained by the distribution of potassium between extracellular and intracellular fluid compartments. Several hormones like (Insulin, Aldosterone, Catecholamines, Glucagon and Growth hormone) might have role in internal potassium balance¹⁵. Hypokalemia is known to occur in therapeutic and excessive doses of β_2 agonists. This effect is attributed to the activation of the Na⁺-K⁺-ATPase Pump and β_2 receptor mediated insulin release which causes intracellular shift of potassium¹⁶. This might be the reason for Hypokalemia in our study however none of the children had severe Hypokalemia.

Limitations of the study

This is single centered study done in small sample size. We already excluded children who were on drugs such as Steroid, Ipratropium bromide and Theophylline as these drugs also have effect on serum potassium level. So, serum Potassium level couldn't be assessed in children

on multidrug therapy as multidrug therapy is one of the modalities of treatment in children with wheeze.

CONCLUSION

Our study concluded that Repeated Salbutamol Nebulization in children aged 12 months to 60 months lead to increase in heart rate and a decrease in respiratory rate and SpO₂. A statistically significant fall in serum potassium level was observed. However, there were no cases of severe Hypokalemia. But monitoring of serum potassium level should be done if the children is on Salbutamol Nebulization as fall in serum potassium can have deleterious effect on children.

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