Seasonal Pseudohypokalemia in Paediatric Patients in Tropical Climate

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ABSTRACT

Background: *During the summer it has been observed, a rise in incidence of hypokalemia in paediatric patients. The phenomenon of seasonal pseudohypokalaemia has been reported previously. High ambient temperature may be a spurious cause of hypokalemia.[1, 2]*

Method: *The study was undertaken to observe the effect of temperature on the level of serum potassium in children. The children in the age group of 1- 14 years, admitted to SVPPGIP, Cuttack, Odisha, were selected for the study. A retrospective record based study was conducted from December 2014 to August 2015.*

Results: *The mean potassium concentration during winter (December2014 to February 2015) was 4.53 ± 0.89 mmol/L and during summer (March 2015 to August 2015) was 4.36 ± 1.19 mmol/L. The mean temperature in summer and winter were 36.18 ± 3.14°C and 29.79 ± 3.16°C respectively. There was a negative correlation (r =-0.118) between serum potassium and ambient temperature (p<0.0001). The proportion of hypokalemic samples was significantly higher in summer than winter with odds ratio 1.507.*

Conclusion: *The high ambient temperature in tropical climate may be the cause of seasonal pseudohypokalemia in paediatric patients. In vitro changes in potassium are more complex than is usually stated in textbooks.[8] The exact timing and temperature are clearly critical in determining the result that is actually reported by the laboratory.*

Keywords: *Pseudohypokalemia, Tropical climate, Paediatric patients.*

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INTRODUCTION

In a tropical country like India, particularly in our state Odisha, the maximum temperature recorded in summer in 2015 was 36.18 ± 3.14°C and maximum temperature during winter was 29.79 ± 3.16°C. We observed a rise in incidence of hypokalemia among paediatric patients in the age group of 1 to 14 years in summer season, which cannot be explained clinically and do not correspond to the status of the patient. The internal quality control for estimation of serum potassium was well within range and good performance report for serum potassium concentration was observed in external quality assurance programme. Under these circumstances, detection of hypokalemia in summer led us to study the seasonal variation in serum potassium concentration in children.

MATERIAL AND METHODS

The indoor patients of SVP PG Institute of Paediatrics Cuttack, Odisha, in the age group of 1 to 14 years with urea, creatinine and blood sugar value within normal range were selected for the study. A retrospective study was undertaken from December 2014 to August 2015 (nine months duration) considering December 2014, January and February 2015 to be the winter season (temperature variation from 29.79 ± 3.16°C) and March 2015 to August 2015 as summer (temperature maximum 36.18 ± 3.14°C). The samples from indoor patients were collected from different wards. The separation of serum by centrifugation was done in batches. The delay time between sample collection and analysis was at least one hour. During that time interval the samples were exposed to the ambient temperature of that particular day, as the sample-processing unit was not an air-conditioned one though the analysis room was air-conditioned. The samples were analyzed in HDC Lyte electrolyte analyzer having Ion selective electrode. The internal quality control was done with control provided by the company and external quality control was with Biorad EQAS.

The samples were grouped according to season: winter and summer. The samples with serum potassium <3.5 mmol/L were considered as hypokalemic. The statistical analysis was performed using IBM SPSS 20. Student t test was applied to find out the difference in means of parametric data and Chi square test was used to find out the different in proportions.

RESULT

The total number of samples analyzed was 4062.

Table 1: Seasonal distribution of temperature and potassium level

	Winter	Summer	t value	p value
Temperature in ^{0}C	29.79 ± 3.16	36.18 ± 3.14	-63.14	< 0.0001
Potassium in mmol/L	4.53 ± 0.89	4.36 ± 1.19	6.497	< 0.0001

Table 1: Shows the mean and standard deviation of temperature and serum potassium concentration in winter and summer season. The mean temperature during winter was 29.79 ± 3.16 0C and during summer was 36.18 ± 3.14 0C.The difference in mean temperature in winter and summer was statistically significant (p<0.0001). The mean serum potassium during winter was 4.54 ± 0.89 mmol/L. and mean serum potassium during summer was 4.36 ± 1.19mmol/L. The difference in mean serum potassium level during winter and summer was statistically significant (p<0.0001).

Table 2: Season wise distribution of hypokalemic samples

	Winter	Summer
Total number of samples	1611	2451
Number of samples with hypokalemia	170	370
Percentage of samples with hypokalemia	10.55 %	15.09 %

Potassium level <3.5 mmol/L is considered as hypokalemia

Chi square = 17.409, p < 0.0001, DF = 1

Odds = 1.507, 95% confidence interval (1.242 – 1.829)

Table 2: Shows in summer out of 2451 samples, 370 (15.09%) were having serum potassium level < 3.5 mmol/L (hypokalemia) whereas in winter out of 1611 samples 170 (10.55%) were found to be having hypokalemia. The difference in proportion of hypokalemic samples was found to be statistically significant (Chi square 17.409, p < 0.0001). In summer the risk of having hypokalemia is 1.507 times higher than that in winter.

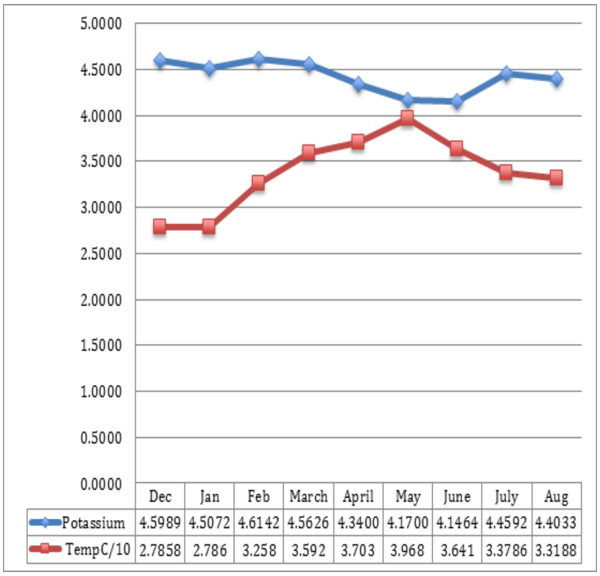

Fig. 1: Line graph of monthly mean serum potassium with monthly mean temperature in degree Celsius/10

Fig. 1: Shows the relation between mean serum potassium in mmol/L and temperature in degree Celsius/10. A negative correlation was observed between mean potassium values and mean temperatures during both the seasons. Pearson correlation coefficient was -0.118 and p <0.0001 which is statistically significant.

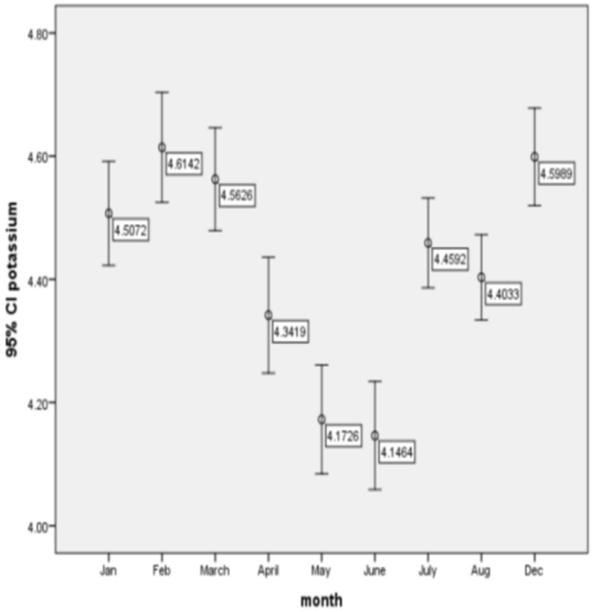

Fig. 2: Error bar showing monthly mean potassium concentration in mmol/L

Fig. 2: Shows error bar of mean potassium concentration in mmol/L in different months. This shows fall in mean serum potassium level in summer months (March to August) in comparison to winter months (December to February). The difference in mean serum potassium level during summer and winter was statistically significant ($p<0.0001$).

DISCUSSION

The study confirms that high ambient temperature is a cause of spuriously low serum potassium concentration in paediatric patients. The number and percentage of cases of hypokalemia were found to be significantly high ($p <0.0001$) in summer than in winter as was previously reported by others.[1-4] Other studies have found a significant fall in plasma potassium with rise in temperature in GP patients[1, 2, 6]. Whereas we have also observed a significant fall in serum potassium concentration in hospitalized paediatric patients. The serum potassium concentration was negatively correlated with temperature ($r=-0.118$). Seasonal pseudohypokalaemia should therefore be considered as a potential cause for unexplained hypokalaemia during hot weather. Higher temperature initially decrease and then increase potassium concentrations probably related to increased usage and exhaustion of glucose that generate ATP for the sodium potassium pump.[5]

In tropical climate the temperature is significantly higher in both winter and summer season than in cold countries. In our place the temperature ranged from 29.79 ± 3.1645 0C in winter and 36.18 ± 3.14 0C in summer. This may be the cause of high incidence of hypokalemia in summer (15.09%) than in winter (10.55%), as compared to previous reporters.1 However another study predicted that the proportion of people in the population with a low potassium could rise from 2.5% to 15% in very hot weather.6 The increase in pseudohypokalemia may be due to increased Na^+ - K^+ ATPase activity.[4] Delayed sample separation (up to 1 hour after venipuncture) may be a cause of spuriously low serum potassium concentration. The preferred method of transporting samples for potassium determination is to centrifuge samples soon after venipuncture.[6]

CONCLUSION

Seasonal pseudohypokalemia during high ambient temperature should be included in differential diagnosis of hypokalemia. The clinicians must be made aware about spuriously low serum potassium otherwise unnecessary patient treatment may be initiated as per the laboratory report.

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