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Hypokalemia in Pediatric Intensive Care Unit: Frequency, Severity and Mortality.

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Abstract: *Hypokalemia is one of the commonest electrolyte abnormality seen in P.I.C.U patients which has profound effect on electrical activity of cardiac, skeletal and smooth muscles.*
Objective: *To study the frequency, severity, risk factors and mortality of hypokalemia.*
Material and methods: This *retrospective cross sectional study was carried out in PICU at Bharati hospital sangli over a period of 3 months.*
Results: *Out of total 153 PICU admissions over a period of 3 months, hypokalemia was found in 50 patients (32.7%). Out of which, 26 (52%) were males & 24(48%) were females. Amongst female patients with hypokalemia, 18(36%) had mild Hypokalemia& 6(12%) had moderate hypokalemia. Amongst Male patients with hypokalemia, 22(44%) had mild hypokalemia and 4(8%)had moderate hypokalemia.12 patients(24%) were less than 1yr ,18 (36%) were 1 to 5 yr old, 11 (24%) were 5 to 10 yr.'s & 9 (18%) more than 10yrs old. The common underlying diseases associated with hypokalemia were, Pneumonia 14(28%), followed by other neurological diseases 8(16%) &Meningoencephalitis4(8%) and others (48%).Mortality rate among hypokalemic patients was (7 deaths out of 50)14%, odds ratio0.313CL-95%(0.094 – 1.043) & p-value 0.048 which is statistically significant.Whereas for non hypokalemic patients death rate was (5 deaths out of 103)4.42%,odds ratio-3.1 CL95%(0.959-10.618).this was statistically significant. In mild hpokalemia group of total 40 patients,there were 4 deaths(10%) odds ratio3.857 CL95%(0.703-21.158). Whereas in Moderate hypokalemia, out of 10 patients 3 died (30%) odds ratio 0.259 CL95%(0.047-1.422). Chances of survival was 3 times more in mild hypokalemia group, though P- values were statistically not significant*
Conclusions: *Hypokalemia is a common problem in PICU patients. It is associated with significantly increased risk of mortality. Majority of patients have mild hypokalemia. ECG changes are nonspecific and are less reliable index of hypokalemia.*
Key words: *hypokalemia, PICU,*

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I. Introduction

Potassium disturbance especially hypokalemia, is known to occur in a number of patients during hospitalization[1]. Hypokalemia can have profound effects on electrical activity in cardiac, skeletal and smooth muscle[2,3]. If severe, these may result in life threatening complications like cardiac arrhythmias, cardiac- arrest, respiratory failure, muscular paralysis and paralytic ileus [1,2,3,4]. Hypokalemia appears to be one of the most common electrolyte disturbances in sick children. Transient causes of hypokalemia are due to intracellular shifts, whereas sustained hypokalemia is caused by either inadequate intake or excessive potassium loss. Studies addressing its incidence and outcome are few[5,6,7,8,9] and chiefly from developed countries. The present study describes our experience with hypokalemia in children admitted to the Pediatric Intensive Care Unit (PICU) with reference to its frequency, severity, associated clinical conditions and mortality.

II. Materials and Methods

This retrospective cross sectional study was carried out in PICU at Bharati hospital sangli over a period of 3 months.Prior permission from the hospital medical superintendant was taken to review the old medical records of PICU patients. This retrospective study has been approved by institutional ethical committee (IEC).

Total of 153 IPD files of PICU patients over a period of 3 months were reviewed. Of this 50 IPD files on review had documentary evidence of hypokalemia. So these 50 IPD were included into the study group. Each IPD file was reviewed in detail in relation to Patient's history, physical examination and systemic examination findings. Information on sociodemographic variables including child's age and gender were noted.systemic examination and laboratory findings, final diagnosis was be made and patients whose serum potassium levels were less that 3.5 meqwas included in the study.

Once the patient was included in the study a stepwise grading of severity (mild, moderate, severe) was done. The severity of hypokalaemia was then correlated with its documented effects on various systems, symptoms such as bradycardia, hypotension, respiratory failure, muscular paralysis and paralytic ileus from past records. Hypokalaemia was defined as 'Serum potassium concentration less than 3.5 mEq/L'. Hypokalaemia was graded as mild if serum potassium ranged between 3.0-3.4 mEq/L, moderate if between 2.0-2.9 mEq/L and severe if <2.0 mEq/L.

The frequency of hypokalaemia was calculated in all study patients in relation to age, sex and expressed as percentage. The frequency of hypokalaemia in various pathological conditions was estimated and compared. The comparison was determined by chi-square or t-test whichever was appropriate. P value < 0.05 was considered as significant. The whole data was put in Microsoft excel sheet and analysiswas done using SPSS version.13 statistics package.

III. Results

Out of total 153 admissions, hypokalemia was found in 50 patients (32.7%). Out of which,26 (52%)were males & 24(48%) were females. Amongst female patients with hypokalemia, 18(36%)had mild Hypokalemia& 6(12%)had moderate hypokalemia.,OR 0.545 CL95% (0.133-2.235)Pvalue-0.365for mild hypokalemia (Female/Male) association . Amongst Male patients with hypokalemia, 22(44%) had mild hypokalemia and 4(8%)had moderate hypokalemia, OR1.833CL95% (0.448-7.511)P-value-0.659. Gender association for both males & female for mild as well as moderate hypokalemia is statistically not significant, though Females are 1.8 times more likely to have moderate hypokalemia than Males (OR=1.8). —chart 1

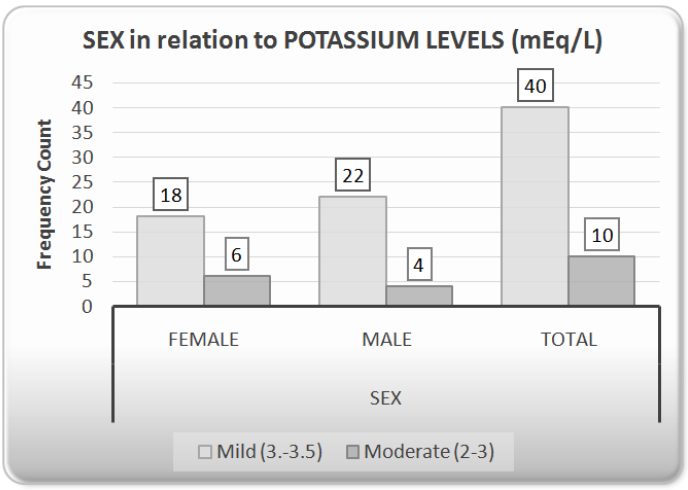

Chart-1

Age wise distribution : 12 patients(24%) were less than 1yr,18(36%) were 1 to 5 yr old, 11 (24%) were 5 to 10 yr.'s & 9 (18%) more than 10yrs old , Chi-square 1.468, P-value > 0.05, P-values for age & severity of hypokalemia association were statistically not significant .(Chart-2)

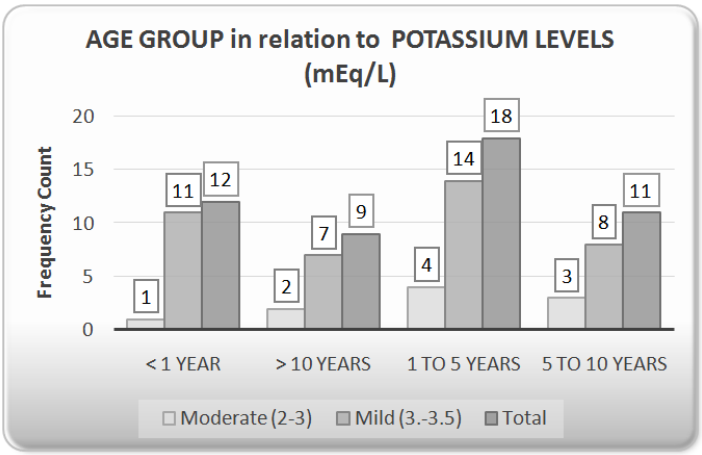

Chart-2

The common underlying disease's, associated with hypokalemiawere ,Pneumonia 14(28%). Followed by other neurological diseases 8(16%) &Meningoencephalitis4(8%), rest are depicted in table 1

diagnosis	**n Number of patients**	
	total	**hypokalemia**
	n=153	**n=50(32.7%)**
Pneumonia (%)	14(28)	
Septicaemia (%)	3(6)	
Diarrhoea with dehydration	2(4)	
Acute renal failure	4(8)	
Heart disease with CCF	2(4)	
Meningoencephalitis	4(8)	
Other neurological causes	8(16)	
Severe acute bronchial asthma	2(4)	
Hepatocellular failure with encephalopathy	3(6)	
Upper airway obstruction	2(4)	
Electric burns	2(4)	
Others	4(8)	

Table-1(Chi square- value22.8, Pvalue >0.05)

The diagnosis in relation to association with hypokalemiaand mortality was statistically non significant, P-values for all diagnosed conditions was >0.05.

Mortality rate among hypokalemic patients was (7 deaths out of 50)14%, odds ratio0.313CL95%(0.094 – 1.043) & p-value 0.048 which is statistically significant.Whereas for non hypokalemic patients death rate was (5 deaths out of 103)4.42%,odds ratio-3.1 CL95%(0.959-10.618).This was statistically significant.—chart3

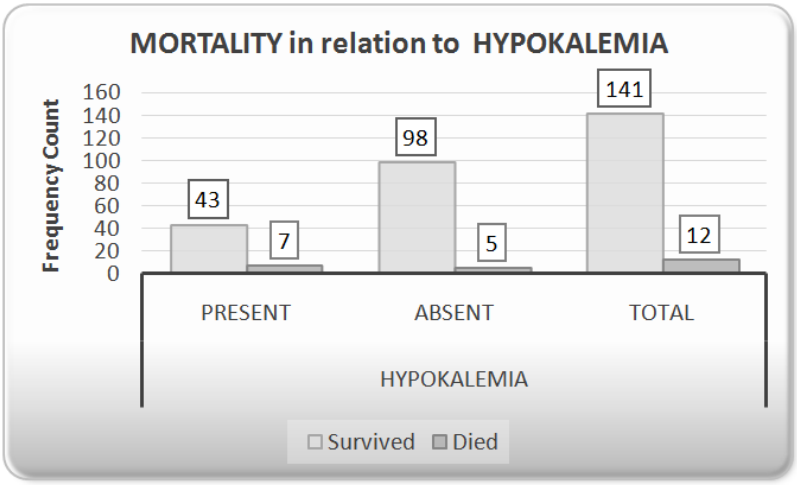

Chart-3 (Chi square-3.895, Pvalue-0.048)

In mild hpokalemia group of total 40 patients,there were 4 deaths(10%) odds ratio3.857 CL95%(0.703-21.158). Whereas in Moderate hypokalemia, out of 10 patients 3 died (30%) odds ratio 0.259 CL95%(0.047-1.422).Chances of survival was 3 times more in mild hypokalemia group, though P- values were statistically not significant. Chart-4

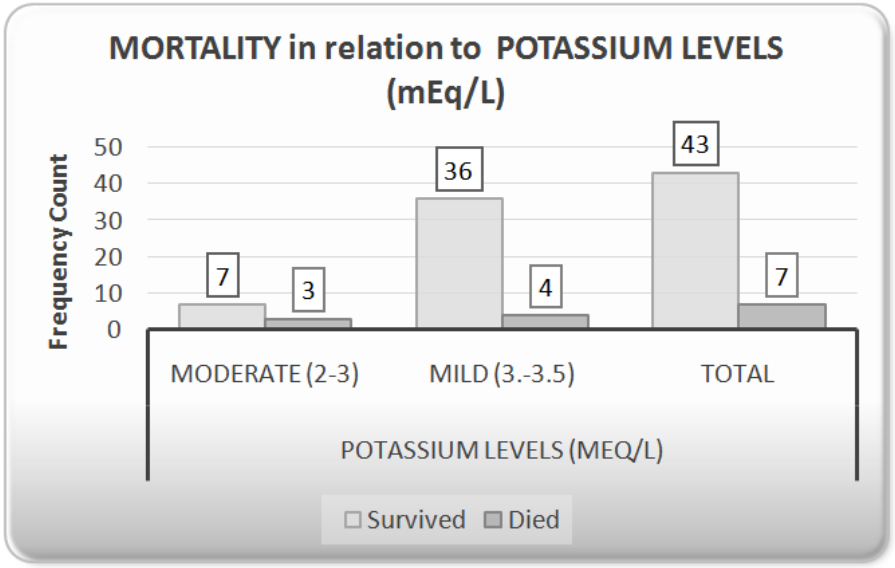

Chart-4

IV. Discussion

This retrospective cross sectional study was carried out at tertiary care hospital, sangli. 50 case records of total 153 PICU admissions were included into the study group.

The frequency and severity of potassium abnormalities and association with mortality in critically ill patients admitted to PICU was described in our tertiary care centre. Our results show that hypokalemia is common among acutely ill children and is associated with a higher mortality.

The frequency of hypokalemia in PICU was found to be 32.7% in our study.Similar results were observed in the studydone by Cummins et al [10], who observed frequency of 40%.Singhi et al reported hypokalemia in14.8% of 290 PICU admissions[5]. The majority of our cases of hypokalemia were mild, Moderate hypokalemia affected 20%,none of patients had severe hypokalemia. Cummins et al reported mild hypokalemia in 57.5% (23.8% out of 40% of total hypokalemic patients)[10],Singhi etal observed moderate hypokalemia in 68.6%[5].

Majority of our patients who had hypokalemia were bellow 5 years of age (60%), which wassimilar to frequency of severity of hypokalemia. Singhi et al reported, 80% of his patients being bellow 5yrs.Gender frequency was equal. Similar findings were reported by Singhi et al,[5]however Cummins et al [10]reported higher incidence amongst females.

Pneumonia was the commonest medical condition associated with hypokalemia in our study, which was seen in 28% of hypokalemia patients. Patients with underlying, meningoencephalitis with other neurological causes, septicemia, bronchial asthma, heart disease with congestive cardiac failure, severe diarrhea, and were most likely to show evidence of hypokalemia. The apparent cause for development of hypokalemia in most patients was a loss of potassium from the body through GI or urinary tract [1,9], either because of underlying disease process, antiasthma medications . In one patient with diabetic ketoacidosis hypokalemia could be attributed to correction of acidosis [11]and use of insulin [12]. In seriously ill patients hypokalemia could also be caused by massive endogenous release of epinephrine because of stress of the illness[13]. High levels of circulating epinephrine cause a shift of potassium from extra cellular fluid to intracellular fluid which might have contributed to hypokalemia. In patients with acute respiratory distress secondary to pneumonia, congestive cardiac failure, and meningoencephalitis, associated inappropriate secretion of ADH may have an important role in development of hypokalemia. It is suggested that ADH acts through some mechanism independent of urine flow[14] and causes increased secretion of potassium in the distal tubules [15].

We observed ECG changes in 2 patients out of 10 patients with moderate hypokalemia, we did not do routine ECG's in all the patients with hypokalemia. The changes observed were in form of "Flat T waves", none had ectopics or arrhythmia. Singhi et al reported ECG changes (mostly Twave changes &ectopics) in 9 patients out of 290 hypokalemic subjects[5]. They observed that relationship between Sr potassium levels and ECG changes were not consistent. Hypokalemia is associatedwith ECG changes like decreased Twave amplitude, ST depression & increased U wave amplitude. However because all these are nonspecific, ECG is less reliable index of hypokalemia[18].

We observed that hypokalemia was associated with significantly increased risk of mortality .we observed mortality rate of 14% in hypokalemia group compared to 4.42% of non hypokalemic group, risk of death was 3 times higher with moderate hypokalemia. Singhi et al observed mortality of 25.6 % in hypokalemic patients compared to 10.9% in non hypokalemic patients[5].In Cummins et al study, on univariate analysis,female gender & severity of hypokalemia was associated with increased mortality, whereas on multivariate analysis this association was not significant[10].Potassium ion is important in regulating 'biologic electricity' and hypokalemia can cause potentially life threatening complications like cardiac arrhythmias or cardiac arrest and muscular paralysis.

V. Conclusions

Hypokalemia is a common problem in PICU patients. It is associated with significantly increased risk of mortality. Majority of patients have mild hypokalemia. ECG changes are nonspecific and are less reliable index of hypokalemia.so it is important to monitor potassium levels in all admitted PICU patients and correction of hypokalemia is necessary to decrease the mortality and morbidity.

Limitation of the study:

Retrospective study and small sample size was the major limitation of our study. The present sample size was not adequate to derive conclusive evidence.

Funding sources: self

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