

Correlation Between Serum Electrolytes And Clinical Outcome in Children Admitted To PICU

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Background: Critical disorders such as severe burns, sepsis, brain damage and heart failure lead to fluid and electrolyte disturbances. A high suspicion, timely recognition and thorough understanding of common electrolyte abnormalities is necessary to ensure their corrections in critically ill children.

Objective: to study the electrolyte abnormalities in PICU children and their association with clinical outcome.

Materials And Methods: This was a hospital based prospective observational study conducted on 132 Pediatric Intensive Care Unit admitted children at Niloufer Hospital, Hyderabad, Telangana. The children were investigated for serum electrolytes and arterial blood gas analysis.

Results: Among the 132 children studied, 71 (53.79%) had electrolyte abnormalities, 26 (19.69%) had metabolic acidosis. In children with electrolyte abnormalities 29 (40.85%) had hyponatremia, 9 (12.68%) had hypernatremia, 13 (18.31%) had hyperkalemia, 8 (11.27%) had hypokalemia. Children with electrolyte abnormality had increased duration of stay in PICU with mean duration of 4.71 days.

In this study, out of 13 deaths, 1 (7.69%) had no electrolyte abnormalities, whereas 12 (92.30%) were associated with electrolyte abnormalities, thus being statistically significant.

Conclusion: Mortality in PICU is mainly linked to primary illness but abnormality of serum sodium and potassium remain significant predictors of mortality. Thus the present study recommends routine monitoring of serum electrolytes in PICU admitted patients.

Keywords: Pediatric intensive care unit, electrolytes, acidosis, critically ill child.

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I. Introduction

Acutely ill children pose a challenge to the pediatrician. Illness can span the spectrum from simple viral infections to life threatening emergencies. Pediatrician needs to distinguish between patients who can be managed with close out patient follow up and those that need to be admitted in PICU for close monitoring [1].

A critically ill child is one who has life threatening illness and injury that can include various acute phases of illness for which continued care and support is needed. Quick recognition and timely intervention in respiratory and or circulatory failure is paramount to prevent progression to cardiac arrest [2]. Critical disorders such as severe burns, sepsis, brain damage and heart failure leads to fluid and electrolyte disturbances. Possible mechanisms include reduced perfusion to the kidney due to hypovolemia or hypotension, activation of hormonal system such as renin angiotensin aldosterone system and vasopressin and tubular damage caused by ischemic or nephrotoxic kidney damage caused by medications used in ICU [3]. So timely recognition, a high suspicion and thorough understanding of common electrolyte abnormalities is necessary to ensure their corrections in critically ill children. Delayed replacement in prolonged electrolyte imbalances will expose the patient to unnecessary risk of morbidity and mortality [3, 4]. Disorder of acid base equilibrium is common in critically ill patients which signals severe underlying pathophysiology and is a significant marker of adverse outcome. In critically ill infants and children it is important to monitor electrolytes and measure proper fluid requirements, because they have greater requirements for water, in proportion to their body weight as compared to adults. The capability of kidney to excrete electrolyte excesses without generous quantities of water is less in them.

II. Aims And Objectives

To study the incidence of electrolyte abnormalities at the time of admission in children in pediatric intensive care unit at Niloufer hospital, Osmania Medical college Hyderabad. To find out the correlation between electrolyte abnormalities and morbidity and mortality in critically ill children.

III. Materials And Methods

This was a prospective observational study, without any specific intervention except the management of primary disease with standard therapeutic protocols, conducted at PICU of Niloufer Hospital, Osmania Medical College, Hyderabad. The duration of study was for 6 months from January 2016 to June 2016.

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Sample size of 140 was taken, 8 excluded later due to lack of data.

2.2 Inclusion Criteria

Children of age 1 month to 14 years admitted to PICU

2.3 Exclusion Criteria

Children with diarrhea and dehydration, children who expired within 1 hour of admission, and children admitted to PICU for <12 hours.

A pre designed semi structured profoma was used to collect detailed demographic and clinical history of each enrolled case. They were evaluated for serum sodium, serum potassium, random blood glucose, serum urea and creatinine. After admission to PICU two blood samples were collected within one hour of admission. One from vein evaluated for sodium and potassium and one from artery which was used for PH and bicarbonate estimation. In lab, electrolytes were measured using ion selective electrode method. Creatinine and urea were measured using Olympus liquid reagent instrument and random sugar by enzymatic peroxidase method. The total duration of stay in PICU and ward and their final outcome was recorded.

Table 1: Parameters

parameter	Value
hyponatremia	Serum sodium <130meq/lit
hypernatremia	Serum sodium>150meq/lit
hypokalemia	Serum potassium<3.5meq/lit
hyperkalemia	Serum potassium>5.5meq/lit
Normal Ph	7.35 to 7.45
Academia	<7.35
Alkalemia	>7.45
Respiratory acidosis	Pco2>45mm of Hg low Ph
Respiratory alkalosis	Pco2<35mm Hg High Ph
Metabolic acidosis	HCO3<22 meq/lit, and low Ph
Metabolic alkalosis	HCO3>26meq/lit and high Ph

Morbidity was defined as stay of patients in PICU for >=5days. Data analysis was done using SPSS 16 version and Chi square was used and P value of <0.05 was taken as statistically significant.

IV. Results

A total of 132 number of cases were studied in 6 months duration out of which 68 (51.51%) were male and 64 (48.48%) were female. In this study 40 patients (30.30%) were of 1 month to 1 year and same in age group 1 year to 5 years, 21 patients (15%) were between 5 to 10 years, whereas 31 (23%) were more than 10 years. Out of 132 patients, electrolyte abnormalities were present in 71 patients (53.79%). In this study, out of 132 patients 26 (19.67%) had metabolic acidosis, none reported metabolic alkalosis.

Table 2: Electrolyte abnormalities according to age

Age group	No. of cases with electrolyte abnormality	No. of cases with normal electrolyte	Total	P value
1month to 1 year	24 (60%)	16	40	P value >0.005 Hence, age group has no statistical significance with electrolyte abnormalities
1yr to 5 yrs	22 (55%)	18	40	
5 yrs to 10 yrs	10 (47%)	11	21	
>10yrs	15 (48%)	16	31	

Table 3: Pattern of electrolyte abnormalities

Electrolyte abnormalities	No. of cases	Percentage
Hyponatremia	29	40.85%
Hypernatremia	9	12.68%
Hyperkalemia	13	18.31%
Hypokalemia	8	11.27%
Mixed	12	16.90%
total	71	100%

Table 4: System wise distribution of cases with electrolyte abnormalities

System	No. of cases and percentage
Central nervous system	35(26.51%)
Cardiovascular system	7(5.3%)

Hematology	9(6.8%)
Respiratory	44(33.33%)
Renal	8(6.6%)
Others	29(21.96%)
total	132(100%)

The mean duration of stay in PICU with normal electrolytes was 3.92 days and for those with abnormal electrolytes was 4.71 days. On comparison of mortality in patients with normal and abnormal electrolytes, in this study out of total thirteen deaths, one patient (7.69%) had no electrolyte abnormality, whereas twelve deaths (92.30%) were associated with electrolyte abnormalities. This was found to be statistically significant ((p value<0.01). In the present, highest mortality was associated with hyperkalemia which was 30.76%, whereas mortality with hyponatremia and mixed disorders was same (23.07%). No death was observed with hypokalemic disorders. This association had statistically significant p value<0.01.

V. Discussion

One hundred and thirty two patients were enrolled of age group 1 month to 14 years. Maximum number of cases admitted in PICU was of age group 1 month to 5 years (60.60%). Out of these, maximum number of electrolyte abnormalities was found in the age group of 1 month to 1 yr age group followed by 1 to 5yrs age group. Mean age of study population was 4.9+_ 11 in year. In S.D Subba rao et al [5] mean age was 4.1+_48.01 year.

Mayank et al [6], study includes age wise distribution of electrolyte imbalance similar to our study, in his study maximum percentage of electrolyte abnormality was observed in the age group of 1 month to 1 year (48%). In the present study, male and female admission ratio was 1:1 similar to the observation seen in study by Mayank et al [6].

Table 5: Comparison table with electrolyte abnormalities with other studies

Study	Percentage
S.D Subba Rao et al[5]	32.45%
G. Muraleetharan et al[7]	82.5%
Mayank Jain et al[6]	31.40%
Present study	53.79%

G.Muraleetharan et al [7], found 13.79% treated in PICU had atleast one electrolyte abnormality and 82.5% had more than one electrolyte abnormalities. Similarly in other studies, S.D Subba rao et al [5], Mayank et al[6], found significant electrolyte abnormalities, 32.45% and 31.54/% respectively.

Table 6: Spectrum of electrolyte imbalances

Electrolyte abnormalities	S.V.SS Prasad et al[8]	S.D Subba rao et al[5]	Mayank Jain et al[6]	Present study
hyponatremia	23.9%	95.50%	40.90%	40.85%
Hypernatremia	-	4.90%	18.18%	12.68%
Hyperkalemia	-	14.40%	18.18%	18.31%
Hypokalemia	-	3.60%	36%	11.27%
Mixed	-	7.90%	-	16.90%
Acidosis	-	7.54%	-	19.61%

Present study shows that there is prolonged duration of stay in case of electrolyte abnormalities (>5 days). This study found hyponatremia leads to prolonged stay. Another study by S.V.SS Prasad et al [8] shows mean duration of hospital stay in children with serum sodium <125meq/lit was significantly longer than those with >131meq/lit.

S.D Subba rao et al [5] study showed risk of increased mortality by 3 to 3.5 times with electrolyte imbalance, out of 99 patients with electrolyte imbalance 25(24.2%) expired. Present study found hyperkalemia with primary illness leads to leads to high mortality rate, in comparison to hypokalemia and other electrolyte disturbances. In present study maximum mortality rate 30.77% was found in hyperkalemia (p value <0.01), cases this results is similar to S.D Subba rao et al [5] .Mayank et al [6] found increased mortality in hypokalemia. S.V.SS Prasad [8], the overall mortality rate showed an increase in hyponatremia. When compared to children with normal serum sodium >131meq/lit, the relative risk of mortality with serum sodium of<125meq/lit was 3.2(95% CI 1.6-6.7) while in those with serum sodium between 126-130meq/lit was 1.8 (95% CI 1.1-3.7). Present study and previous studies all found electrolyte abnormalities increase mortality in critically ill children, whether it is sodium or potassium abnormality.

VI. Conclusion

The present study showed high incidence of electrolyte abnormalities in patients admitted to PICU. Hyponatremia was the most commonly encountered dyselectrolytemia and was mostly found associated with respiratory illnesses. The mean duration of stay was significantly higher than patients who had normal

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electrolyte levels. Mortality in PICU is mainly linked to primary illness, but abnormality of serum sodium and potassium remain significant predictors of mortality. Thus, the present study recommends routine monitoring of serum electrolytes in PICU admitted patients.

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