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Original Research Article

Clinical Profile and Outcome of Electrolyte Disturbances in Children Aged I Month to 12 Years in Pediatric Intensive Care Unit of a Tertiary Care Hospital

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Abstract

Introduction: The treatment of different electrolyte imbalances is an essential component of life-supporting care in an intensive care unit, especially for young patients. Pediatric intensive care units frequently experience electrolyte imbalances.

Aims: To evaluate the electrolyte imbalance trend in pediatric critical care. to determine the many causes of electrolyte imbalances. To evaluate how electrolyte imbalances affect mortality, length of PICU admission, and after effects.

Materials & Methods: This was a prospective, observational cohort study conducted in the Department of Pediatric Medicine at Calcutta National Medical College and Hospital, a tertiary care center. The study was carried, from 2021 to 2022, and included a total of 150 pediatric patients.

Result: In 38 patients (25%) in our investigation, dyselectrolytemia was most frequently seen as mixed abnormalities. 36 patients (24%), 32 patients (21%), and 27 patients (18%) had hyponatremia, metabolic acidosis, and hypokalemia, respectively. Hyperkalemia (12 patients, 8%), hypocalcemia (9 patients, 6%), hypernatremia (6 patients, 4%), and hypercalcemia (5 patients, 3%), were less common anomalies. ($p< 0.00001$) It was statistically significant.

Conclusion: We concluded that the bulk of the 150 pediatric patients in our study who were admitted to the PICU were male newborns between the ages of one month and one year. Central nervous system infections were the most common underlying cause, and mixed electrolyte imbalances were the most commonly found.

Keywords: PICU, Hypernatremia, Hypokalaemia, Metabolic acidosis and Mortality.

Introduction

The treatment of different electrolyte imbalances is an essential component of life-supporting care in an intensive care unit, especially for young patients. Pediatric intensive care units frequently experience electrolyte imbalances. They frequently share clinical characteristics of underlying disorders, which calls for a high index of suspicion even though they don't always exhibit particular symptoms. [1]. When critically ill pediatric patients are admitted to pediatric intensive care units (PICUs), electrolyte imbalances are a frequent and serious consequence. These imbalances are frequently caused by therapeutic interventions, underlying disease processes, or a mix of the two. Maintaining cellular homeostasis, nerve conduction, muscular function, and acid-base balance all depend on electrolytes like sodium, potassium, calcium, and bicarbonate. Any change in their concentration has the potential to negatively impact several organ systems and have a significant impact on patient outcomes [2,3].Due to their developing physiology, limited physiological reserves, and the severity of their underlying illnesses, children—especially those between the ages of one month and twelve are more susceptible to electrolyte imbalances. These abnormalities are frequently brought on by conditions like sepsis, dehydration, infections of the central nervous

system, renal failure, and gastrointestinal diseases [4]. Furthermore, the electrolyte balance of these patients may become much more complicated if IV fluids, diuretics, and other drugs are used in the PICU [5]. Among the most common sodium abnormalities seen in pediatric critical care are hyponatremia and hypernatremia. A serum sodium level below 135 mEq/L is known as hyponatremia, and it can result in neurological symptoms ranging from moderate disorientation to seizures and, in extreme and acute cases, coma. On the other hand, because it affects brain dehydration and cellular malfunction, hypernatremia—a blood sodium level exceeding 145 mEq/L—is linked to significant mortality and morbidity rates. To avoid neurological consequences and mortality, these illnesses need to be closely watched and treated promptly. Hypokalemia and hyperkalemia are two equally important potassium abnormalities. While hyperkalemia can result in potentially fatal cardiac arrest if left untreated, hypokalemia can cause respiratory failure, cardiac arrhythmias, and muscle weakness.Another common electrolyte-related disturbance that has important prognostic implications in pediatric critical illness is metabolic acidosis, which frequently results from sepsis, renal failure, or diabetic ketoacidosis. The purpose of the study is to evaluate the electrolyte disturbance pattern in pediatric intensive care. To determine the many causes of electrolyte imbalances. To evaluate how electrolyte imbalances affect mortality, length of PICU admission, and aftereffects.

Materials and Methods

Type of study: This was a prospective, observational cohort study.

Place of study: Department of Pediatric Medicine, at Calcutta National Medical College and Hospital.

Study Duration: Approximately one year, from 2021 to 2022.

Sample Size: 150 Paediatric patients

Inclusion Criteria: Children aged between 1 month and 12 years who were admitted to the PICU were included in the study.

Exclusion Criteria: Patients were excluded if they had congenital anomalies, known metabolic disorders, nephrotic syndrome, chronic diseases, or had received fluids and electrolytes prior to admission.

Study Variables

- Electrolyte disturbances were identified at the time of admission through detailed history-taking, which included information on age, sex, chief complaints, and relevant past medical history.
- Laboratory evaluation included serum levels of sodium, potassium, calcium, and arterial blood gas (ABG) analysis. Electrolyte imbalances were classified based on standard reference ranges for each parameter.
- Special medications
- Mechanical ventilation
- Inotropic support

Statistical Analysis: Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages.

Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Result

Table 1: Age Distribution of Children with Electrolyte Disturbances

Age Group	Number of Patients (n)	Percentage (%)	P - value
1 month – 1 year	75	50.00%	< .00001
>1 year – 5 years	45	30.00%	
>5 years – 12 years	30	20.00%	
Total	150	100%	

Table 2: Sex Distribution of Children with Electrolyte Disturbances

Sex	Number of Patients (n)	Percentage (%)	P- value
Male	85	56.70%	0.02088
Female	65	43.30%	
Total	150	100%	

Table 3: Incidence of Dyselectrolytemia among study subjects

Dyselectrolytemia	Number of Patients	Percentage	P- value
Hyponatremia	36	24%	< .00001
Hypernatremia	6	4%	
Metabolic Acidosis	32	21%	
Hypokalemia	27	18%	
Hyperkalemia	12	8%	
Hypocalcemia	9	6%	
Hypercalcemia	5	3%	
Mixed abnormalities	38	25%	
Total	150	100%	

Table 4: Underlying illness in children with Dyselectrolytemia

Underlying illness	Number of Patients	Percentage	p- value
Central nervous system infections	107	71%	< .00001
Respiratory diseases	23	15%	
Renal diseases	11	7%	
Septicemia	33	22%	
Gastrointestinal diseases	11	7%	
Multi system involvement	33	22%	
Total	150	100%	

Table 5: Association between outcome of children with dyselectrolytemia: Group

Dyselectrolytemia	Survival	Deceased	P value
Hyponatremia	14 (58.4%)	10 (41.6%)	0.025
Hypernatremia	1 (25%)	3 (75%)	<0.001
Normonatremia	59 (82%)	13 (18%)	0.02
Hypokalemia	11 (61%)	7 (39%)	0.02
Hyperkalemia	3 (37.5%)	5 (62.5%)	0.01
Normokalemia	60 (81%)	14 (19%)	—
Hypocalcemia	3 (50%)	3 (50%)	<0.022
Hypercalcemia	3 (100%)	0 (0%)	—
Normocalcemia	68 (75%)	23 (25%)	—
Metabolic acidosis	13 (62%)	8 (38%)	<0.001

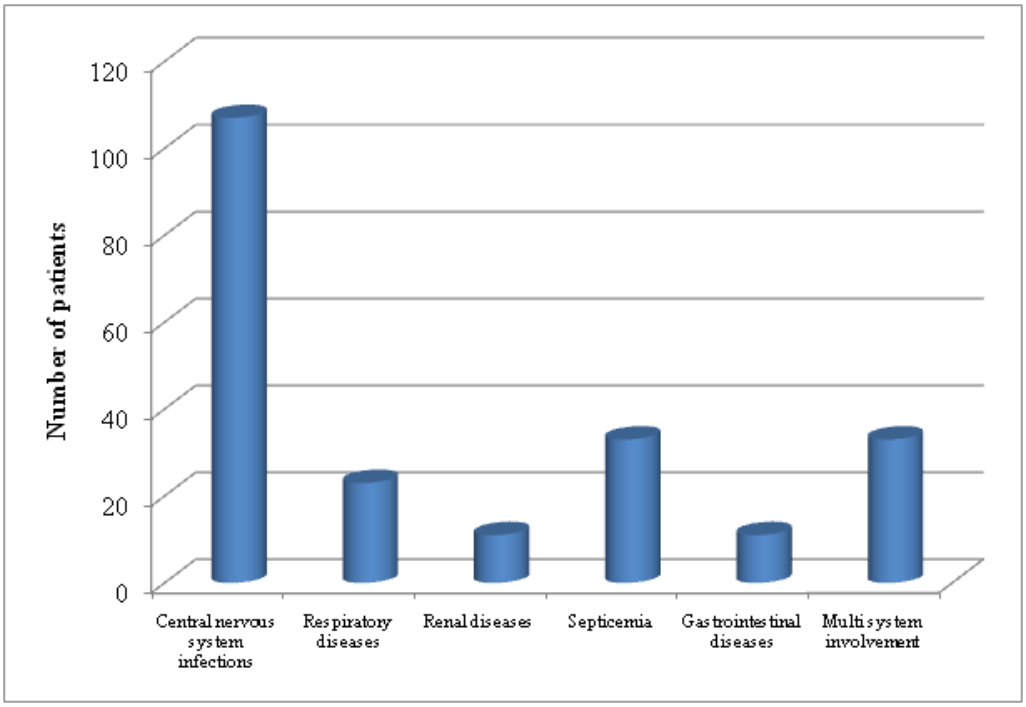

Figure 1: Underlying illness in children with Dyselectrolytemia

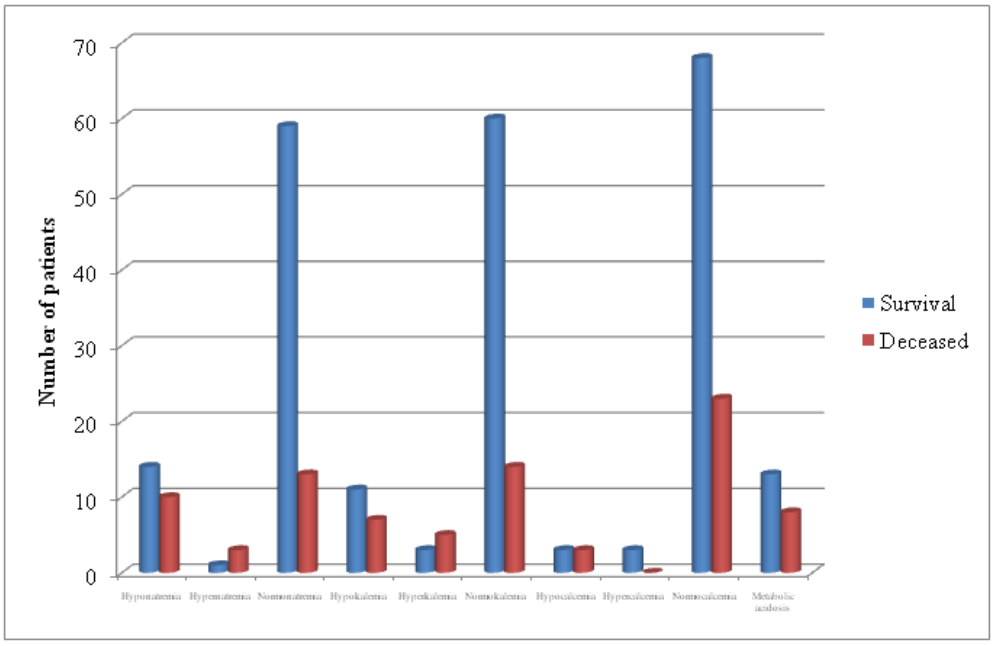

Figure 2: Association betweenoutcome of children with dyselectrolytemia: Group

In our study of the patients in our study, 75 (50%) were between the ages of one month and one year, 45 (30%) were between the ages of one and five, and 30 (20%) were between the ages of five and twelve. (p< 0.00001) It was statistically significant. The majority of the 150 pediatric patients with electrolyte abnormalities in our study were male (85, or 56.7%), with 65 (43.3%) being female. At p = 0.02088, it was statistically significant. In 38 patients (25%) in our investigation, dyselectrolytemia was most frequently seen as mixed abnormalities. 36 patients (24%), 32 patients (21%), and 27 patients (18%) had hyponatremia, metabolic acidosis, and hypokalemia, respectively. Hyperkalemia (12 patients, 8%), hypocalcemia (9 patients, 6%), hypernatremia (6 patients, 4%), and hypercalcemia (5 patients, 3%), were less common anomalies. (p< 0.00001) It was statistically significant. Infections of the central nervous system accounted for 107 individuals (71%), followed by respiratory disorders in 23 patients (15%) and renal disorders in 11 patients (7%). Thirty-three patients (22% each) had septicemia and multi-system involvement, while eleven patients (7% each) had gastrointestinal disorders. (p< 0.00001) It was statistically significant. Different kinds of dyselectrolytemia have different survival rates in our study. Hypernatremia had the highest mortality rate (75%, p < 0.001), while normokalemia and normonatremia had the highest survival rates (82% and 81%). Hyperkalemia and hypocalcemia were linked to greater death rates (50–62.5%), while hyponatremia, hypokalemia, and metabolic acidosis had moderate survival rates (58–62%). Every hypercalcemic patient lived. There was statistical significance in these differences.

Discussion

In our study, out of 150 patients most of the patients were 1 month – 1 year years old [75 (50.0%)] which was statistically significant (p< .00001).In similar study by This is consistent with several studies reporting that infants within this age group represent the highest proportion of pediatric intensive care admissions. Singh et al. [6] (2018) found that 48% of PICU admissions were infants aged 1 month to 1 year. Similarly, Gupta et al. [7] (2019) reported 52% of admissions in this age range, emphasizing their vulnerability.

We found that, male population was higher [85 (56.7%)] than the female population [65(43.3%)]. Male: Female ratio was 1.3:1 but this was statistically significant (p=0.02088).In others study byLee OJ et al. [8] (2017) also showed male predominance with 59% and 54% respectively.

We observed that mixed electrolyte abnormalities were observed in the highest number of patients—38 out of 150 (25%). This was statistically significant (p < 0.00001) In similar study Fernandez et al. [9](2021) noted 26% mixed electrolyte disorders in a multicenter study. We found that central nervous system infections were present in the highest number of patients 107 out of 150 (71%) It was statistically significant (p < 0.00001).

In other study by Gupta et al.[10] (2019) found CNS infections in 70% of their cohort. We observed that normonatremia was present in 72 patients, with 59 (82%) surviving and 13 (18%) deceased (p = 0.02), while normokalemia was seen in 74 patients, with 60 (81%) surviving and 14 (19%) deceased, indicating better outcomes with

normal sodium and potassium levels. All 3 patients with hypercalcemia survived. In contrast, hypernatremia was associated with the highest mortality, where 3 out of 4 patients (75%) died ($p < 0.001$).

Similarly, hyperkalemia showed high mortality with 5 out of 8 patients (62.5%) deceased ($p = 0.01$). Among 24 patients with hyponatremia, 10 (41.6%) died ($p = 0.025$), and in 18 patients with hypokalemia, 7 (39%) were deceased ($p = 0.02$). Metabolic acidosis was present in 21 patients, with 8 deaths (38%) ($p< 0.001$), while hypocalcemia, seen in 6 patients, had an equal split of 3 survivors and 3 deceased ($p < 0.022$). These findings indicate that hypernatremia and hyperkalemia were strongly associated with increased mortality, whereas normal electrolyte levels were linked to better survival outcomes.

Conclusion

We concluded that analysis of 150 pediatric patients admitted to the PICU revealed that most of them were male newborns between the ages of one month and one year. Central nervous system infections were the most common underlying cause, and mixed electrolyte imbalances were the most commonly found. While normonatremia and normokalemia were linked to improved outcomes, electrolyte imbalances, especially hypernatremia and hyperkalemia, were strongly linked to increased mortality. These results highlight how crucial it is to identify electrolyte abnormalities in critically ill infants early, monitor them frequently, and treat them promptly. In the pediatric intensive care unit, identifying high-risk groups can aid in enhancing clinical results, lowering mortality, and directing suitable management techniques.

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