Study of electrolyte imbalance in critically ill children

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ABSTRACT
BACKGROUND: Electrolyte abnormalities are common in children admitted for critical care in pediatric intensive care unit. They occur in a variety of conditions, may remain unrecognized and result in morbidity and mortality irrespective of the primary problem. Objective: To study prevalence of electrolyte imbalance, its relationship with the primary problem and its impact on morbidity and mortality. MATERIALS AND METHODS: All patients admitted for critical care in PICU during January 2014 to December 2015 were included in study except those with acute diarrheal disease. Patients were stabilized, investigated and managed as per standard protocol, Proforma were filled and analysis done. RESULTS: 70 patients were enrolled during the study period. Mortality seen in 16 cases (22.9%). Electrolyte disturbance was prevalent in 22 out of 70 patients enrolled (31.4%). 13 cases out of total 16 mortalities had electrolyte disturbances (81.2%)(p value = 0.0030). Out of 70 patients enrolled 25(35.7%) were infants (<1 year of age) and Electrolyte disturbance were seen in 12 out of them(48%). Out of 22 patients with electrolyte disturbances, 14 had sodium (63%), 12 had potassium (52%) and 1 had calcium (4.5%) disturbances. Mixed abnormalities were seen in 5 cases (22.7%). SIADH was detected in 5 cases (22.7%). CONCLUSION: Electrolyte disturbances are frequently observed in patient requiring PICU care. Prevalence of electrolyte disturbance is very high in patient with mortality. Prevalence of electrolyte disturbance is significantly high in critically ill infant. Sodium imbalance in form of hyponatremia was the most common observed abnormality and SIADH was seen in significant number of patient.

Keywords: Electrolyte imbalance, critically ill child.

Introduction
Water is the most abundant constituent of the human body. Human body has 60-70% of weight due to its water content¹. Water occupies two main fluid compartments
1. Intracellular fluid (ICF)- about two third by volume, contained in cells
2. Extracellular fluid (ECF)- about one third by volume, consist of two major subdivisions
   ➢ Plasma – the fluid portion of the blood
   ➢ Interstitial fluid- fluid in spaces between cells
Specialized ECF- lymph, cerebrospinal fluid, eye humors, synovial fluid, serous fluid and gastrointestinal secretion.
In the fetus and newborn, the ECF volume is larger than the ICF volume. The normal postnatal diuresis causes an immediate decrease in ECF volume. This is followed by continued expansion of the ICF volume, which results from cellular growth. By 1 year of age, the ratio of the

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expansion of the ICF volume, which results from cellular growth. By 1 year of age, the ratio of the ICF volume to the ECF volume approaches adult level.

Water is the universal solvent. Solutes are broadly classified into:
➢ Electrolytes- inorganic salts, all acids and bases, some proteins
➢ Nonelectrolytes- glucose, lipids, creatinine, urea etc.
Electrolytes are dissolved in body fluids. Each fluid compartment of the body has a distinctive pattern of electrolytes. This reflects the activity of cellular ATP-dependent sodium-potassium pump. Ion fluxes are restricted and move selectively by active transport.
Sodium is a predominant extracellular cation and chloride is predominantly extracellular anion. Bicarbonate also is an extracellular anion. Potassium is the predominately intracellular cation and phosphates are the predominant intracellular anion.
Electrolytes are important for:
➢ Neuromuscular excitability
➢ Secretory activity
➢ Membrane permeability
➢ Controlling fluid movements
Normal serum SODIUM (Na+) concentration is 135-145 meq/L. Sodium is unique among electrolytes because water balance, not sodium balance, usually determine its concentration. **Hyponatremia** is <135 meq/L, classified on basis of the overall volume status of the body³. **Hypernatremia** is >145 meq/L. Sodium intoxication frequently iatrogenic, classification based on relative concentration of sodium and water in body³.

**Potassium (K+)**: Normal serum potassium: 3.5 to 5.5 meq/L. The intracellular concentration of potassium is 150 meq/L, maintained via the Na+,K+-ATPase, which is much higher than the plasma concentration. **Hyperkalemia** S. K+ > 5.5 meq/L **Hypokalemia** S. K+ < 3.5 meq/L. Too little potassium causes hyper-polarization and non-responsiveness and disrupt electrical conduction in the heart which can lead to sudden death.⁴

**Calcium**: Very important electrolyte for muscle, bone and neuro-electrical activity. Most common manifestation involving hypocalcemia is related to decrease bony mineralization and osteoporosis. Hypercalcemia associated with vomiting, dehydration, failure to thrive.

**MATERIAL AND METHOD:**
All patients admitted for critical care in PICU during the study period of 1 year (January 2014-December 2014) were included in study except those with acute diarrheal diseases. Patients first stabilized, investigated and managed as per standard protocol. 2 venous samples with 1 urine sample were collected in all cases.

- 1st blood sample- s.Na+, s.k+ and s.ca++ estimation
- 2nd blood sample and urine sample – labeled and kept for work up for diagnosis of SIADH, as and when required.

If the initial serum Na level < 135 meq/L and patient are clinically euvoletic then urine spot Na, urine and serum osmolarity were estimated. If potassium level more than 6meq/L then ECG was advised.

Data collected and fisher S test, Chi-squire test applied to test significance of difference in morbidity and mortality in patient with normal and abnormal electrolytes.

**RESULTS**
Total 70 patient admitted in PICU, 22 (31.4%) were having electrolyte imbalance. From 16 patients who expired 13 (81.2 %) had electrolyte imbalance, which was much more compared to patient who were discharged (9/54) (p value 0.0030) (Figure 1).

**Figure 1: Prevalence of electrolyte disturbances**

**Figure 2: Age and electrolyte imbalance**

Electrolyte imbalance is frequently seen in infant (48%-12/25) compared to total patients presented with imbalance (Figure 2).

**Figure 3: Sex and electrolyte imbalance**
Out of total 70 patients, 37 were male and 33 were female (Figure 3). Out of total 22 patients, equal number of patients fell in both sexes.

Out of 70 patients, 14 patients (20%) had sodium imbalance, and 12 patients (17%) had potassium imbalance, and only 1 patient had calcium imbalance (Figure 4). Out of 22 patients with electrolyte imbalance, 14 (63%) had sodium imbalance, 12 (52%) had potassium imbalance, and 1 (4.5%) had calcium imbalance. Total no of patients with hyponatremia, hypernatremia, hypokalemia, and hyperkalemia were respectively 9, 4, 4, 8 and mortality was seen in 5, 2, 3, 5 patients (Figure 5).

**DISSCUSSION:**
Electrolyte abnormalities were observed in 31.4% of children getting admitted to PICU. Hyponatremia was the commonest, found in 12.8% cases. In a study conducted in adults, 6.9% of total admissions had hyponatremia. A higher frequency of 29.8% was observed in the prospective study of 727 sick children. Twenty per cent children in that study had diarrhea. In another study, 34% of hospitalized patients were classified as hyponatremic. Since children with diarrhea were not included in our study, this may explain the lower incidence of hyponatremia in the present study.

Hyperkalemia was second most common seen in 5.7%. These findings are in comparative to those by Singhi et al., who found hyperkalemia in 5.4% PICU admissions.

Hypokalemia was the less common electrolyte abnormality. However a significantly higher frequency (13.9, 14.8%) was observed in two other studies. Again this difference is explained by inclusion of patients with diarrheal diseases in these studies.

**REFERENCE**

In a prospective study, 27% of patients with infectious diseases admitted to a PICU, were seen to have hyponatremia. Other patients with hyponatremia had either diarrheal disease (20%), pneumonia (19%) or central nervous system disorders (12%). Singhiet al showed that 10.8% of patients with hyponatremia had an underlying neurologic disorder and hyponatremia persisted in 4.3% of them after treatment of the underlying disorder. This could be due to the difference in the pattern of PICU admissions in these studies where only 10.3% were CNS diseases.

**CONCLUSION:**
- Electrolyte disturbances are frequently observed in patient requiring PICU care.
- Prevalence of electrolyte disturbance is very high in patient with mortality
- Prevalence of electrolyte disturbance is significantly high in critically ill infant.
- Sodium imbalance in form of hyponatremia was the most common observed abnormality and SIADH was seen in significant number of patient.

**REFERENCES:**