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PATTERN OF ELECTROLYTE PROFILE AMONG ADMITTED CHILDREN (1-18 YEARS) AT THE UNIVERSITY OF CALABAR TEACHING HOSPITAL, NIGERIA.

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Background: Electrolyte imbalances among children, if not well managed, have deleterious effects that can lead to increased mortality and morbidity. This study takes into consideration the pattern and profile of electrolyte imbalance among children aged 1-18 years that were admitted for various ailments over a six month period at the University of Calabar Teaching Hospital in Southern Nigeria.
Method: This observational study was done at the University of Calabar Teaching Hospital (UCTH). Children aged 1-18 years who were admitted for more than 24hours for various ailments were investigated for electrolytes over a 6-month period. All patients on electrolyte therapy were excluded from the study. Also, patients with congenital or acquired electrolyte abnormalities were excluded from the study. Results were obtained daily for each patient after collecting blood into the appropriate sample bottles. Various values of electrolyte obtained were compared with the reference intervals to ascertain the level of deviation from the expected normal for age.
Results: A total of 227 children participated in the study which was made up of 108(47.6%) males and 119(52.4%) females in the ratio 0.9:1.Children aged 1-5 years made up of a bulk of the study population accounting for 55.9%. The study showed that the commonest electrolyte abnormality detected by the studied population was a low level of bicarbonate accounting for 52.9% of all the children. Children aged 1-5 years accounted for 34.8% of children with low bicarbonate levels. Children aged 6-12 years were 11.9%, and those aged 13-18years were 6.2%. Hyponatremia was the next commonest type of electrolyte abnormality in the children, accounting for 39.6% of all sodium

abnormalities in the study population.54.6% had normal sodium level and 3.1% had mildly elevated sodium levels. Again, the children aged 1-5 years old had the higher prevalence of hyponatremia (22.9%). Thus, the group of children aged 1-5 year had both the commonest electrolyte abnormalities for both low bicarbonate levels and low hyponatremia. In relation to other age groups, the difference was statistically significant at p value of 0.017.

Conclusion: Just like in adults, electrolyte imbalances are common clinico –laboratory presentations with varied manifestations. Therefore, adequate attention should be drawn to these clinical features to properly manage the patients with such presentations.

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INTRODUCTION

Serum electrolytes are useful in the general metabolic processes and their imbalances in infants and children are not uncommon[1]. Common electrolytes usually assayed in both adults and infants are sodium, potassium, calcium, magnesium and occasionally lithium[2]. Imbalance in any of them may have to leave adverse effects on the affected patients. This may range from increased mortality and morbidity of affected patients, increased length of stay in the hospital, increased financial demand and expenses on the patient and overall health experts on the part of the government among other psychological demands on the patient[2, 3]. Electrolyte imbalance is a common finding in children of all age groups, and this is so in the tropical countries where most patients are usually victims of fluid losses from various etiologies[4, 5, 6]. An optimal balance of body electrolytes is critical to overall health and thereby maintaining homeostasis. Electrolytes aid in enhancing muscle functions, maintaining the acid-base status of the body and maintaining the body fluid level[4]. And so, increased health burden on the managing physician and health team is a great consequence of the aforementioned[7].

Globally, electrolyte imbalance is a common clinical-laboratory finding in all age groups in the tropical countries[8]. Electrolyte imbalance is more sensitive in infants than in adults. This is usually triggered mostly by some level of dehydration and over hydration. In infants, a fluid loss of 50ml/kg constitutes mild dehydration whereas up to 100ml/kg or 150ml/kg are classified as moderate and severe dehydration respectively[4, 5.In] children, severe pyrexia and gastroenteritis cause dehydration. Infants can tolerate very high losses of fluids before electrolyte imbalance exist. Studies on electrolyte metabolism and pattern in pediatric infants are not fully available in our environment. Yet, infants are more vulnerable to electrolyte imbalance[9]. Based on this, this study is aimed at assessing the profile and pattern of electrolyte imbalance among children (1-18 years) in our environment.

MATERIALS AND METHODS

This observational study was done in conjunction with the pediatrics department and health record unit (HRU) of the University of Calabar Teaching Hospital (UCTH). Ethical clearance was obtained from the UCTH hospital and Research committee. Over a 6-month period, children who were admitted into UCTH and were investigated for electrolytes and creatinine following admission after a stay of more than 24 hours in the hospital were enrolled for the study. Blood samples were taken from such patients for sodium, potassium, urea, bicarbonate. The patients were followed up from the time of admission to the period of discharge. All patients on electrolyte therapy were excluded from the study. Also,

patients with congenital or acquired electrolyte abnormalities were excluded from the study. All electrolyte values were obtained by an electrolyte auto-analyzer *(Labjeniks Electrolyte Analyser, Germany)* and the results were obtained daily for each patient after collecting blood into the appropriate sample bottles which were spun and assayed for serum electrolytes. The reference intervals that were marked for each of the parameter assayed are given as Na (135-145mmol/L), K (3.5-5.5mmol/L), Hco_3 (22-30mmol/l), Urea (2.5-6.7mmol/l), and creatinine (81.7-120mmol/l). Various values of electrolyte obtained were compared with the reference intervals to ascertain the level of deviation from the expected normal for age.

STATISTICAL ANALYSIS

Statistical analysis was done using **SPSS** for windows version 18. All variables were reported as mean value ± standard deviation for the valuables. A *p*-value often than 0.5 was concluded to be statistically significant. Appropriate statistics were used to analyze the data.

The total number of children that participated in the study was 227, made up of 108(47.6%) males and 119(52.4%) females in the ratio 0.9:1. see the pie chart. The children were classified based on their different ages and were all aged from1 year to 18 years. The frequencies are represented below. Children aged 1-5 years made up of a bulk of the study population accounting for 55.9%(See figure 1) Pattern of electrolytes were depicted as either was low, normal or high for sodium, potassium chloride, urea, bicarbonate, and creatinine for all children of age groups.

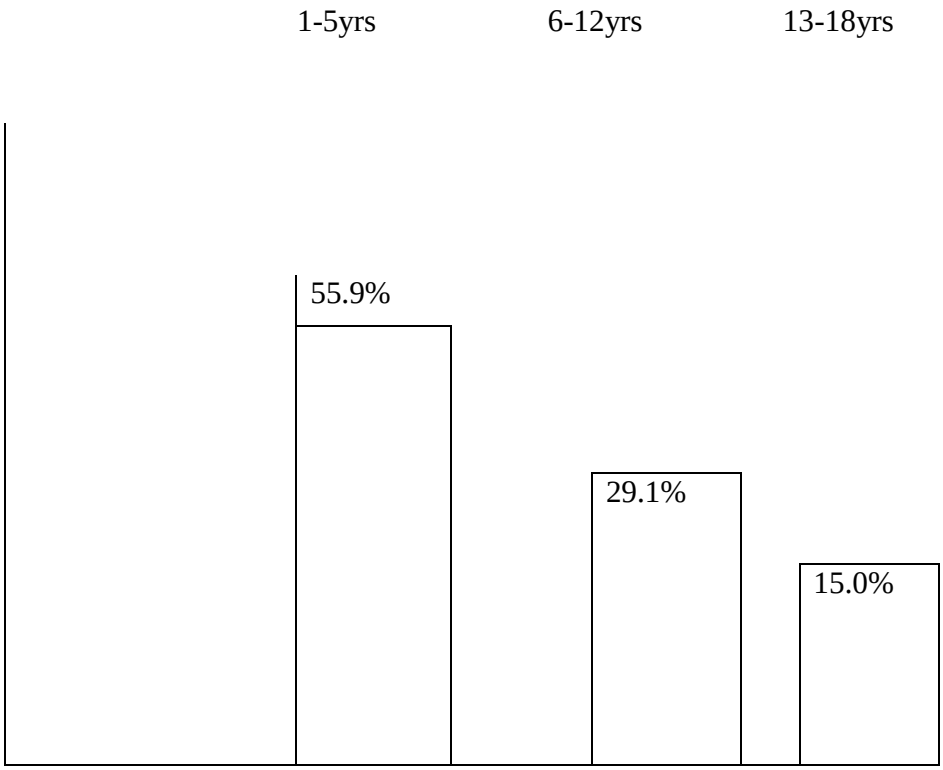

Figure 1: Bar chart showing the distribution of the studied age groups

Table 1: Table showing the pattern of the hyper- and hypo-levels of the electrolytes

Analytes	Low (%)	Normal (%)	High (%)
Sodium	42.3	54.6	3.1
Potassium	14.1	75.3	10.6
Chloride	9.7	81.5	8.8
Urea	16.3	62.6	21.2
Creatinine	14.6	74.0	11.5
Bicarbonate	52.9	46.7	4.0

The pattern of electrolyte displayed showed that the commonest electrolyte abnormality detected by the studied population was a low level of bicarbonate accounting for 52.9% of all the children. This was manifested as metabolic acidosis. It followed that low aged children had more cases of acidosis (low bicarbonate) than higher aged children. Children aged 1-5 years accounted for 34.8% of children with low bicarbonate levels. Children aged 6-12 years were11.9%, and those aged 13-18years were 6.2%. Next was followed by low sodium levels (hyponatremia) as the next commonest type of electrolyte abnormality in the children, accounting for 39.6% of all sodium abnormalities in the study population.54.6% had normal sodium level and 3.1% had mildly elevated sodium levels. Again, the children aged 1-5 years old had a higher prevalence of hyponatremia (22.9%). Thus, the group of children aged 1-5 year had both the commonest electrolyte abnormalities for both low bicarbonate levels and low hyponatremia. In relation to other age groups, the difference was statistically significant at a *p*-value of 0.017. Summarized information on the above findings is given in table 2 below.

Table2: Summarized information on the electrolyte imbalance in relation to age

Element	Status	1-5yrs	6-12yrs	13-18yrs	Total
Sodium	Low	52(22.9%)	28(12.4%)	16(7.0%)	90(39.6%)
	Normal	71(31.3%)	35(15.4%)	18(7.9%)	124(54.6%)
	High	4 (1.8%)	3(1.3%)	0 (0%)	7(3.1%)
Bicarbonate	Low	79(34.8%)	27(11.9%)	14(6.2%)	120(52.9%)
	Normal	48(21.1%)	38(16.7%)	20(8.8%)	106(46.7%)
	High	0 (0%)	1(0.4%)	0 (0%)	1(0.4%)

The gender distribution of low electrolyte abnormalities detected showed that female children accounted for about 29.1% and 22.1% respectively of low bicarbonate and hyponatremia respectively. Both high and low bicarbonate abnormalities were shown to be higher in females compared to male, but the difference is not statistically significant (p=0.426) Similarly, gender representation of elevated and normal electrolyte pattern is given below in table3:

Table 3: Gender distribution of elevated analytes/electrolytes.

Analyte	Male	Female	Total
Bicarbonate	0(0%)	1(0.4%)	1(0.4%)
Sodium	3(1.3%)	4(1.8%)	7(3.1%)
Potassium	13(5.7%)	11(4.8%)	24(10.5%)
Chloride	8(3.5%)	12(5.3%)	20(8.8%)
Urea	20(8.8%)	28(12.3%)	48(21.1%)
Creatinine	15(6.7%)	18(7.9%)	33(14.6%)

DISCUSSION

Hyponatremia is said to occur when sodium level is <130mmol/L. Aetiological factors responsible include water retention as a result of impaired excretion, sodium loss exceeding water loss as seen in thiazide use[10, 11, and 12]. Three types of hyponatremic conditions exist and they include: Hyperosmolar (Serum Na <130; plasma osmol> 295), Iso- osmolar (Serum Na < 130; plasma osmol 280-295) and Hypo-osmolar (Serum Na < 130; plasma osmolarity<280)[13]. This study evaluated the frequency and characteristics of the electrolyte profile in children aged 1-18 years. Children aged 1-5 years made up the bulk of the study population (55.9%) admitted into the tertiary facility. This is in keeping with the fact that children within this age range are more susceptible to infections and other health challenges, thus leading to increased hospital visits[14, 15]. Balaji *et al* corroborated this in their study where children less than one year had a higher prevalence of electrolyte derangement when compared with other age groups[16]. Notably, most of the study population had a normal range electrolyte pattern. Most of the study population had metabolic acidosis of which children aged 1-5 years had a higher frequency. The second common electrolyte abnormality is seen as hyponatremia. Electrolytes are substances that ionize when dissolving in suitable solvents. Electrolytes also known as solutes are distributed between the intracellular and extracellular fluids and they contribute to the osmolality of the fluid in the body. Electrolyte derangement occurs in a variety of conditions but may remain undetected thus resulting in morbidity and mortality in the child. Understanding of electrolyte abnormalities leading to early detection is useful in the reduction of morbidities and mortalities. According to Okposio et al in a study done among 185 children admitted for acute watery diarrhea at the University of Benin Teaching Hospital, the electrolyte most deranged was sodium[17]. The reason adduced was the inappropriate treatment given at home prior to admission. Again, Elala et al in their study among 384 children admitted in a hospital in Addis Ababa found a prevalence of 45.1% for electrolyte abnormalities[18]. The commonest deranged electrolytes were hyponatremia (23.2%) followed by hypokalaemia (22.1%). No reason was given except that the deranged electrolyte was associated with the background illness. When comparing the age range 1-5yrs with 6-18yrs, the frequency of hyponatremia was greater in the lower age group. This emphasizes the need for critical fluid management in the lower age group. The difference in the frequency of both electrolyte abnormalities was statistically significant. This differed from the study by Elala et al in Addis Ababa where the predominant electrolyte derangement was hyponatremia followed by hypokalaemia[18]. Okposio et al in their study in Benin City also differed as hyponatremia was prevalent but this was specific for acute watery diarrhoea[17]. Metabolic acidosis and hyponatremia were seen more in females than males though it was not statistically significant. Balaji et al corroborated these findings though no reason

was given[16]. Quantity of fluid the body needs daily to maintain fluid balance takes into account normal insensible water lost in urine & stool assuming the patient is afebrile and relatively inactive. It's greater for low birth weight (LBW) and preterm infants. Dehydration is the depletion of body fluids resulting in a state of negative fluid balance that may be caused by a number of disease entities. Treatment of electrolyte derangement can be with the administration of oral rehydration solution, Ringer's lactate, Half Strength Darrow, and normal saline. Most patients respond appropriately following treatment for electrolyte imbalance.

CONCLUSION:

This study shows that electrolyte imbalance is a common presentation even among children admitted into the hospital. Signs and symptoms of this may be vague in most patients and so serial electrolyte assay as part of the management modality by physicians may be a useful way of attending to the affected patients.

CONFLICT OF INTEREST:

The authors declare no conflict of interest to disclose.

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