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Three Serum Electrolytes Profile (Na^+, K^+ and Cl^-) of Anaemic Patients at the Biyem-Assi District Hospital in Yaounde (Cameroon)

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Abstract: This study aimed to evaluate the prevalence of serum sodium, potassium and chlorine disorders on anaemic patients and to assess their effects and measures of managing it. A prospective study was conducted on 110 patients at the Biyem-Assi District Hospital (Yaounde, Cameroon). Normal serum concentrations of sodium, potassium and chlorine were considered as 136 – 145 mEq/l, 3.5 – 5.0 mEq/l and 96 – 106 mEq/l respectively. The variables were considered significant when $P < 0.005$. Out of the total number of people recorded, there were 81 females (73.64 %) and 29 males (26.36 %). The prevalence of sodium imbalance hyponatremia, and hypernatremia are 20 (18.18 %) and 0 (0 %) respectively. The prevalence of potassium imbalance hypokalemia and hyperkalemia were 12 (10.91 %) and 14 (12.73 %) respectively. The prevalence of chloride disturbance, hypochloremia and hyperchloremia were 2 (1.82 %) and 21 (19.09 %) respectively. Amongst the variables chosen, only three variables had p-values that were significant that is sodium and level of education, potassium and occupation, and potassium and diarrhoea, but some were not significant for the study. Hyponatremia and hyperkalemia were highly prevalent in anemic patients. The severity of serum sodium, potassium and chlorine disturbances on anemic patients remains a significant predictor of mortality. Thus, correcting electrolyte disturbances in these anemic patients is important. Serum chloride levels showed no particular pattern or significant difference on the various variables.

Keywords: Anaemia, Serum Electrolyte Disturbance, Sodium, Potassium, Chlorine

1. Introduction

Anaemia is the most common disorder of the blood. There are several kinds of anaemia, produced by a variety of underlying causes. Anaemia can be classified in a variety of ways, based on the morphology of RBCs, underlying etiologic mechanisms, and discernible clinical spectra, to mention a few [1].Haemoglobin threshold varies with age, sex and pregnancy but generally, haemoglobin values of < 12.0g/dl (6.8mmol/l) are diagnostic of anaemia[2].Nine out of ten anaemia sufferers live in developing countries: about 2 billion people suffer from anaemia and an even larger number of people present iron deficiency [3].Anaemia may contribute to up to 20% of maternal deaths. In tropical and developing countries, anaemia is particularly prevalent with about 50% or more of pre-school children and pregnant women being moderately or severely anaemic [4]: with the prevalence in Cameroon between the years of 1999 – 2004 being 68.3% amongst pre-school children, 50.9% amongst pregnant women and 44.3% amongst non-pregnant women of reproductive age [2]. In the United States, 20% of all women of childbearing age have iron deficiency anaemia, compared with only 2% of adult men. An electrolyte is any substance containing free ions that make the substance electrically conductive [5]. In physiology, the primary ions in electrolytes include sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), chloride (Cl^-), hydrogen phosphate (HPO_4^{2-}), and hydrogen carbonate (HCO_3^-) [6]which have very diverse functions including: signal transduction, muscular contraction, maintenance of osmolality and fluid

balance, nervous transmission, blood clotting, and enzyme function etc[7].They are found in blood, urine and body fluids and can be gotten from foods eaten and fluids drunk [8].Levels of electrolytes in the body can become too low or too high and particular subjected to the changes of the water levels in the body. Some causes of these imbalances include drugs, malnutrition, vomiting, diarrhoea, sweating, or kidney problems [9].Anaemia thus may lead to changes in electrolyte homeostasis and initiates the occurrence of further complications if not properly managed. This research work and its findings were to provide information and elucidate the need for electrolyte assessment and management in anaemia.

The main aim of this study is to determine the electrolyte disturbances that arise in patients diagnosed to be anaemic at the Biyem-Assi District Hospital, Yaounde-Cameroon.

The general objective was to determine the electrolyte disturbances that occur in patients presenting with anaemia and propose improved methods for managing anaemic patients. The specific objectives wereto determine the prevalence of each electrolyte disturbance amongst anaemic patients by measuring electrolyte concentrations; to determine the influence of gender and age on electrolyte status in anaemic states; to determine the influence of diarrhoea, vomiting, level of education and occupation onelectrolyte status in anaemic patients.

2. Materials and Methods

2.1. Study Area

This research work was done at the Biyem-assi District Hospital, Yaounde-Centre Region of Cameroon.

2.2. Study Population

This study was multi-ethnic thus constituting people from diverse ethnic groups in Cameroon. It also included foreigners from countries such as Nigeria, Equatorial Guinea and other neighbouring African countries. The study was a prospective and observational study.

2.3. Sample Size

Using the population census of Yaounde (2009 estimate) which is 1,616,000 and statistics from the population influx at the hospital, with a confidence limit of 5 % at a confidential level at 80 %, 164 participants were targeted, consisting of patients diagnosed to have anaemia. Blood specimens were collected from persons of all age groups and sexes. This sample size was considered using Lorenz formula.

2.4. Sampling Method

This work was solely hospital based with the sampling technique being more of purposive sampling. Blood specimen were collected from all patients presenting with clinical manifestations of anaemia and acute blood loss, consulted with a physician and have been requested for investigation for anaemia (full blood count), within the study period and areas.

2.5. Inclusion Criteria

Anaemic patients of all age groups and sex who visited the hospital at the said periodand children whose parents gave their assent for participation in the study.

2.6. Exclusion Criteria

We excluded from our study:

- Persons that had records to be sufferers of other diseases such as hypertension, kidney disease, diabetes, sickle cell anaemia specific hormonal disorders and other related complications which may be possible risk factors to electrolyte disturbances.

Also pregnant women were exempted from this study.

2.7. Sample Collection

All patients requesting to do Full Blood Count were potential candidates for the study if willing. To participate, they were asked to read the consent form and sign before becoming eligible for the study. Thereafter, the filling of the questionnaire was done.

For haematological tests, the anticoagulants used are EDTA (ethylenediamine tetra acetic acid), also called sequestrene, and *tri*-sodium citrate. These chemicals prevent blood from clotting by removing calcium.

Electrolyte analysis can be analysed using Serum, Whole Blood or Plasma.

In this research, we used serum.

Specimens werecollected by venepuncture into an untreated (red topped) tube. The tube filled to at least 2/3 of the total volume. The time of collection noted;

The blood samples were allowed to stand for 20-30 minutes for clot formation;

The clots were rimed with an applicator stick, the tubes centrifuged for10–15 minutes and the serum removed to clean specimen tubes;

Serums were analysed immediately, some stored at 4°C for 24hours, or frozen at -20°C for up to one week. Those stored samples were brought to room temperature and mixed well before assaying.

2.8. Ethical Consideration

An ethical clearance (N^{o} 2014/07/192/L/CNERSH/SP) was obtained on the 3th July 2014 from the Cameroon National Ethics Committee for Research on Humans. Additionally, an informed consent was used were each participant had to read and then signed before being accepted for the study.

2.9. Statistical Analyses

Data was analysed at 80% confidence interval using Epi-Info 3.5 statistical software package. Prevalence of sodium, potassium and chlorinewere calculated amongst anaemic patients in percentages. For statistical analysis, Epi Info 7 package was used in the study. All values were expressed as

mean ± SD. Continuous variables were compared using student's test. For all analysis '*p*' value< 0.05 was defined as significant. Fischer test was applied to assess the significant.Also, the relationships betweenanaemia-induced electrolyte and the following were done using Fisher test analysis: age, sex and level of education and occupation as well as withdiarrhoea and vomiting.

2.10. Laboratory Measurement

Samples were collected from suitable participants within the study areas and period, and assayed for sodium, potassium and chloride. Assay techniques were exclusively made use of ion selective electrode technology.

3. Results

This study was done on 110 anaemic patients of which 81 are female (73.64 %) and 29 male (26.36 %), and the following variables were considered;

Electrolytes imbalance and age group, sex, level of education, gender, diarrhoea and vomiting, level of education as well as occupation. In figure 1, 81.82%of the anaemic patients had normal sodium concentration, 18.18% had hyponatraemia and none had hypernatraemia. It was noticed that 76.36% of the population had normal potassium concentration, 10.91% had hypokalaemia and 12.73% had hyperkalaemia as seen in figure 2.In figure 3, 79.09 % of the population had normal chloride concentration, 1.82% had hypochloraemia and 19.09% had Hyperchloraemia.

To note; the result was considered significant when P< 0.005. As concern sex and gender, they are independent risk factor of electrolyte imbalance. Out of the number studied those who were with diarrhoea and hyponatraemia outweighed those without diarrhoea. This is in accordance with other studies as seen in table 1.We realized that those that answered to not vomiting outweigh those that answered yes (table 1).

It is noticed that most of the imbalances were due to diarrhoea with a *p*-value = 0.008 that is all the hypokalaemia had diarrhoea and only 2 of the hyperkalaemia were without diarrhoea (table 2). For chlorine, majority of the patients had diarrhoea while only a few answered yes to vomiting (table 3).

As concerns the relationship between level of education and sodium imbalance, the most affected were those at the tertiary levelas seen in table 4. For potassium imbalance and the level of education, the most affected group was tertiary for hyponatraemia and secondary for hypernatraemia see table 5.in table 6 we realised that in chloride and level of education, most affected were those of the secondary for hypochloraemia and primary for hyperchloraemia.

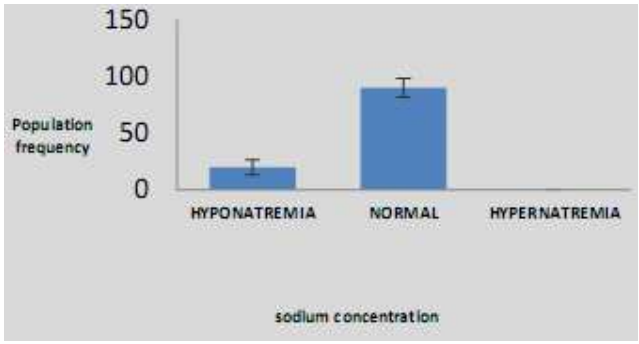

Figure 1. *Prevalence of sodium imbalance on the total population.*

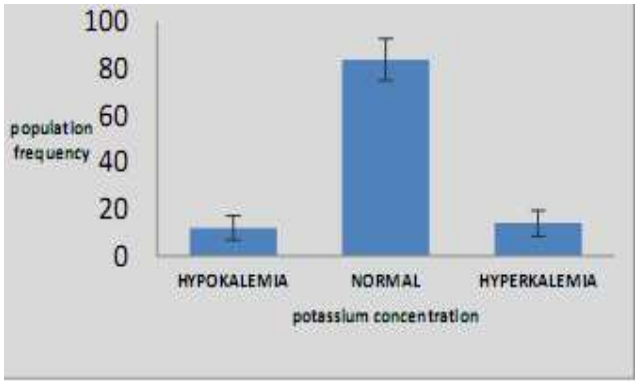

Figure 2. *Prevalence of potassium imbalance on the total population.*

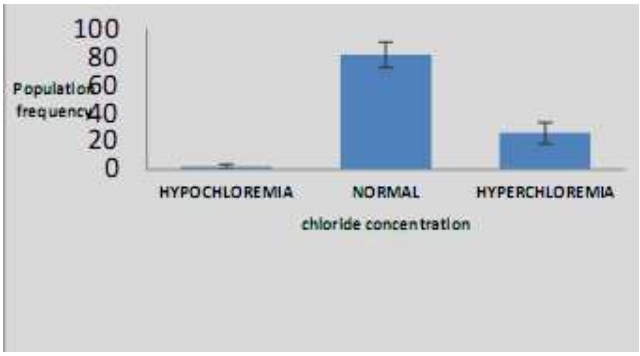

Figure 3. *The prevalence of chloride disturbance on the total population.*

Table 1. *Association between sodium imbalance with diarrhoea and vomiting.*

SODIUM(Na^+)				
Do you have diarrhoea?	Hyponatraemia	Normal	Hypernatraemia	p-values
No	3	22	-	0.556^F
Yes	17	68		
Do you vomit?	Hyponatraemia	Normal	Hypernatraemia	
No	17	65	-	0.394^F
Yes	3	25		

F= results obtained using the Fisher's exact test

Table 2. *Association between potassium imbalance with diarrhoea and vomit.*

POTASSIUM (K^+)				
Do you have diarrhoea?	Hypokalaemia	Normal	Hyperkalaemia	p-values
no	0	23	2	0.008[F]
yes	12	61	12	
Do you vomit?	Hypokalaemia	Normal	Hyperkalaemia	
no	8	64	10	0.700[F]
yes	4	20	4	

F= results obtained using the Fisher's exact test

Table 3. *Association between chlorine disturbance with diarrhoea and vomit.*

CHLORIDE(Cl^-)				
Do you have diarrhoea?	Hypochloraemia	Normal	Hyperchloraemia	p-values
no	0	20	5	1[F]
yes	2	67	16	
Do you vomit?	Hypochloraemia	Normal	Hyperchloraemia	
no	1	66	15	0.509[F]
yes	1	21	6	

F= results obtained using the Fisher's exact test

Table 4. *The relationship between level of education and sodium imbalance.*

SODIUM (Na^+)				
Level of education	Hyponatraemia	Normal	Hypernatraemia	p-values
Null	0(0.0%)	10(100%)		
Primary	7(20.6%)	27(79.4%)		
Secondary	4(16.7%)	20(83.3%)		0.592[F]
High school	2(20.0%)	8(80.0%)		
Tertiary	7(22.6%)	24(77.4%)		

F= results obtained using the Fisher's exact test

Table 5. *The relationship between level of education and potassium imbalance.*

POTASSIUM (K^+)				
Level of education	Hypokalaemia	Normal	Hyperkalaemia	p-values
Null	0(0.0 %)	7(70.0 %)	3(30.0 %)	
Primary	3(8.8 %)	24(70.6 %)	7(20.6 %)	
Secondary	0(0.0 %)	22(91.7 %)	24(70.6 %)	0.002[F]
High school	1(10.0 %)	9(90.0 %)	0(0.0 %)	
Tertiary	8(25.8 %)	21(67.7 %)	2(6.5 %)	

F= results obtained using the Fisher's exact test

Table 6. *The relationship between chloride disturbance and level of education.*

CHLORIDE(Cl^-)				
Level of education	Hypochloraemia	Normal	Hyperchloraemia	p-value
Null	0(0.0 %)	9(90.0 %)	1(10.0 %)	
Primary	1(2.9 %)	22(64.7 %)	11(32.4 %)	
Secondary	1(4.2 %)	17(70.8 %)	6(25.0 %)	0.512
High school	0(0.0 %)	7(70.0 %)	3(30.0 %)	
Tertiary	0(0.0 %)	26(83.9 %)	5(16.1 %)	

F= results obtained using the Fisher's exact test

Table 7. *The association between sodium imbalance and occupation.*

SODIUM (Na+)				
Occupation	Hyponatraemia	Normal	Hypernatraemia	p-value
Baby	0(0.0 %)	6(100.0 %)		
Civil servant	0(0.0 %)	2(100.0 %)		
Hair dresser	2(28.6 %)	5(71.4 %)		
Housewife	0(0.0 %)	17(100.0 %)		0.004[F]
Mechanic	2(100.0 %)	0(0.0 %)		
Pupil	3(23.1 %)	10(76.9 %)		
Retired	1(11.1 %)	8(88.9 %)		
Student	9(29.0 %)	22(71.0 %)		

SODIUM (Na+)		
Tailor	1(16.7 %)	5(83.3 %)
Teacher	1(9.1 %)	10(90.9 %)
Trader	1(16.7 %)	5(83.3 %)

F= results obtained using the Fisher's exact test

Scientific honesty allows us to admit that this study was not perfect, and thus, its limits are to be précised; Inaccessibility to remote areas where there exist increased rates of anaemia; Sick individuals who do not come to the hospital; Responses to questionnaire for individuals who can neither read nor write;

Impossibility of being at all sample collection sites at the same time for supervision since the work was going on simultaneously; Lack of quality assurance and quality control in the hospital;

4. Discussion

In figure 2, 81.82% of the anaemic patients had normal sodium concentration, 18.18% had hyponatraemia and none had hypernatraemia. This is because hypernatraemia is very rear [10], uncommon [11, 12] and Hypernatraemia is much less common because it is associated with increased plasma osmolality [12-14].

Out of the total population of sodium concentration and those that had hyponatraemia are those with age group 24-29. This result is in accordance with that obtained by [7,12,13]which show that increase in age is a strong independent risk factor for both hypo and hypernatraemia.

We noticed that out of the total number of potassium imbalance, the majority of hypokalaemiacases were from the age group of 30-35 while and those with hyperkalaemia were from the age group 0-5. There is no significant difference between potassium and age (p-value = 0.5185) [13,16,17].

Gender is not an important risk factor for disturbances of serum electrolytes concentration [7,12,13,16,18].

The cause of the hyponatraemia was due to loss of fluid as affirmed by [12,19]. Also, causes of hyponatraemia with decreased extracellular volume in the gut is due to vomiting, Diarrhoea and Haemorrhage [10,13].The result obtained showed that the p-value = 0.556 which implies there is no significant difference between sodium imbalance and diarrhoea Association between potassium imbalance with diarrhoea and vomiting.

It was noticed that most of the imbalances were due to diarrhoea with a p-value = 0.008 that is all the hypokalaemia had diarrhoea and only 2 of the hyperkalaemia were without diarrhoea implying that diarrhoea is a cause of potassium imbalance, [4,10,13] There is a significant difference which imply there is a relationship between potassium and diarrhoea. As for vomiting, majority of the patients answered 'NO' to vomiting but most of the study showed that vomiting is an associated factor of potassium imbalance.

Chlorine disturbances shows no significant difference with respect to diarrhoea and vomiting although most of the patients showed that their imbalances to chlorine was due to fluid loss as noticed in [20,21]. As concerns the relationship between level of education and sodium imbalance, the most affected were those at the tertiary level. The reason may be because of negligence [12]. For potassium imbalance and the level of education, the most affected group was tertiary for hyponatraemia and secondary for hypernatraemia. Here, the p-value is significant and in accordance with [4,10,3]. Potassium and the level of education had a significant difference as the p-value was below 0.005.This shows that the level of education is a problem when it comes to potassium imbalances. Those with hypokalaemia were those with level of education tertiary while those with hyperkalaemia were those from secondary. This can be as a result of poor hygienic practice [12]or even due to certain medications due to negligence [22].

Occupation affects sodium imbalance can be explained by the fact that most occupations are stressful and tedious and can result to brain fatigue thereby causing loss of appetite [13,21].

5. Conclusion

The results of this study showed high prevalence of hyponatraemia and hyperkalaemia in anaemic patients. The severity of serum sodium and potassium concentrations remains a significant predictor of mortality.

Amongst the variables chosen, age and gender had no significant difference. We observeda significant difference in potassium and diarrhoea, potassium and level of education and sodium and occupation.

Serum chloride levels showed no particular pattern or significant difference among the variables like age, sex, level of education, occupation, vomiting and diarrhoea.

No specific pattern was observed in chloride level imbalance.

The clinicians are advised to closely monitor these electrolytes imbalances and correct them as they seem to have adverse effects on disease outcome. Thus, correcting electrolyte disturbances in anaemic patients is a necessity.

Based on the findings of the study, as well as observations made, we recommend that;

Research should be done on other variables apart from those considered in this work;

Personnel be trained on how to advice patients on electrolyte imbalances;

The same study should be carried out in other regions of the nation so that results could be compared.

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