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ESTIMATION OF SERUM SODIUM AND POTASSIUM IN PATIENTS WITH SEVERE MALARIA, ATTENDING WAD MEDANI TEACHING PEDIATRIC HOSPITAL, GEZIRA STATE, SUDAN

Mohammed Saeed E. Eltayeb[1] and Azhari A. Mohammed Nour*[2]

[1]Department of Basic Medical Sciences, Faculty of Applied Medical Sciences, Albaha University, Albaha City, Saudi Arabia.
[2]Department of Basic Medical Sciences, Faculty of Applied Medical Sciences, Albaha University, Albaha city, KSA.

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***Corresponding author: Azhari A. Mohammed Nour**

Department of Nutrition & Food Sciences, Faculty of Science Technology, Omdurman Uslamic University, Omdurman, Sudan.

ABSTRACT

Malaria is a serious parasitic infection, which infects human red blood cells. It is transmitted from one person to another by the bite of female *Anopheles* mosquitoes infected with *Plasmodium sp*. Early diagnosis and treatment are important to prevent the complications of severe infection, like renal disease and electrolyte disturbance. This is a case-control study aimed to estimate serum sodium and potassium levels in severe malaria patients. Sixty venous blood samples were collected, 30 of them were collected from patients with severe malaria and the other 30 samples were collected from healthy individuals attending Wad Medani Teaching Pediatric Hospital from May to August 2017. Serum sodium and potassium were estimated by using Cobas c 311. The data was collected through a questionnaire and analyzed by the statistical package for social science (SPSS). This study concludes that there is a significant decrease in serum sodium and potassium levels in severe malaria patients compared to the control group [Na ± SD (130.93 ± 6.52) in cases, (137.47 ± 2.70) in the controls with significant P-value (0.000) and K ± SD (3.80 ± 0.5) in cases, (4.07 ± 0.6) in controls with significant P- to value (0.041)]. The present study recommended that serum electrolytes should be estimated and managed in malaria patients of all age groups to prevent complications, which may result from electrolyte depletion.

KEYWORDS: Malaria, *Anopheles* mosquitoes, *Plasmodium sp*, sodium, potassium.

INTRODUCTION

Malaria is a parasitic infection, which infects human red blood cells. It is transmitted from one person to another by the bite of female *Anopheles* mosquitoes. The parasite must go through a complex cycle in both mosquito and human before transmission can take place. In the mosquito vector, the cycle lasts for 1-3 weeks, depending on several factors, such as the type of parasitic species. Four species of *Plasmodium* can cause malaria in humans; these are P. falciparum, *P.vivax*, *P.malariae*, and *P.ovale*. *P.falciparum* is responsible for most of the deaths and most of the severe complications that result from malaria (Nchida, 1998). This includes cerebral malaria, anemia, and renal failure (Kocha, 2003). Malaria is endemic in many tropical and subtropical climates. It is a mosquito-borne disease that spreads by the bite of the *Anopheles* mosquito and rarely by blood transfusion. The species that are mainly prevalent in Sudan are *P.falciparum* and *P.vivax* (Park, 2007). *P.falciparum* is the most pathogenic and disease which runs an acute course in non-immune patients and is frequently fatal if untreated (Arora, 2015). The possible pathogenic mechanism of the infection, which result in tissue ischemia, involves the sequestration of parasitized red blood cells in the microvasculature of internal organs, mainly due to cytoadherence, decrease deformability of the infected red cells (Chen, 2000).

The most reliable method for diagnosing malaria is the microscopic examination of patient's stained blood films (Giemsa stain) by a trained microscopist, thick films are more useful than thin in the detection of low-density malaria parasitemia, several new but more costly rapid diagnostic tests are now available. However, these do not replace microscopy as the standard method for the diagnosis of severe malaria, culture of malaria parasites, serodiagnosis, rapid antigen detection tests, molecular diagnosis, and fluorescence microscopy. Sodium and Potassium are two electrolytes that are required for human survival. Electrolytes are positively and

negatively charged particles that control the distribution of fluids throughout the body. They regulate the passage of fluids across cell membranes, which is important for maintaining a state of fluid balance and for transporting nutrients and waste in and out of cells (Clay McNight, 2014). Sodium is the most abundant cation in the extra-cellular fluid (ECF), representing 90% of all extracellular cations, and largely determines the osmolality of the plasma. The plasma Na+ concentration depends on the intake and excretion of water and to a somewhat lesser degree, on the renal regulation of Na+. Three processes are of primary importance: 1- the intake of water in response to thrust, as stimulated or suppressed by plasma osmolality, 2- the excretion of water, largely affected by anti-diuretic hormone (ADH) release in response to changes in either blood volume or osmolality, 3- the blood volume status which affects Na+ excretion through aldosterone, angiotensin II and ADH. Hyponatremia is serum Na+ level less than 135 mmol/L, causes of hyponatremia are increased Na+ loss, increased water retention, and water imbalance. Hypernatremia is increased serum Na+ concentration; more than 145 mmol/L, result from excess water loss, decreased water intake and increased Na+ intake or retention. Potassium is the major intracellular cation in the body, with a concentration 20 times greater inside the cells than outside. Three factors that influence the distribution of K+ between cells and ECF, : 1- K+ loss frequently occurs whenever the Na+, K+ -ATPase pump is inhibited by conditions such as hypoxia, 2- insulin promotes acute entry of K+ into skeletal muscle cells and liver by increasing Na+, K+ -ATPase activity and 3- catecholamine promote cellular entry of K+. Hypokalemia is plasma K+ concentration below the lower limit of the reference range, due to decreased intake, GIT loss, renal loss, and cellular shift. Hyperkalemia results from decreased renal excretion, cellular shift, increased intake, and artefactual. (BISHOP, 2013). Electrolyte disturbances are known to be common in severe complicated malaria; hyponatremia has long been recognized as a complication of malaria. (Miller LH, 1967). The objective of the study is to estimate serum electrolytes (Na+, K+) in severe malaria patients attending Wad Medani Teaching Pediatric Hospital.

RESEARCH METHODOLOGY

Methodology

Study design

Case-control, hospital-based study.

Study area

This study was conducted in Wad Medani, Teaching Pediatric Hospital, Gezira State, Sudan.

Sample size

A venous blood sample was collected from 60 participants (30 samples were collected from patients with severe malaria, and the other 30 samples were collected from healthy individuals as a control group).

Inclusion criteria

All patients diagnosed as having severe malaria, attending Wad Medani Teaching Pediatric Hospital at the period from May to August 2017.

Exclusion criteria

- Any patients suffering from renal disease.
- Patients under treatment that affect sodium or potassium level.

Data collection

Data was collected through a questionnaire.

Data Analysis

The data were analyzed by the statistical package for social science (SPSS) and it was presented in percentage forms.

Ethical consideration

The specimens and information that were collected from patients, weren't used for any purpose rather than this study. Ethical approval was obtained from the University of Gezira ethical committee, the medical laboratory. Target population was informed about the study objectives and was consented prior filling questionnaires. Confidentiality and privacy of target population was guaranteed.

Methods

Sample collection and preparation

Under the quality control and safety procedure for sample collection, 4 ml of the venous blood sample was collected from each participant into a tube containing lithium heparin anticoagulant. The blood was thoroughly mixed with the anticoagulant, and after centrifugation, the serum was taken for electrolyte analysis.

Laboratory analysis and procedures

Serum sodium and potassium were measured by Cobas c 311 using Ion-selective electrode techniques.

RESULTS AND DISCUSSION

Results

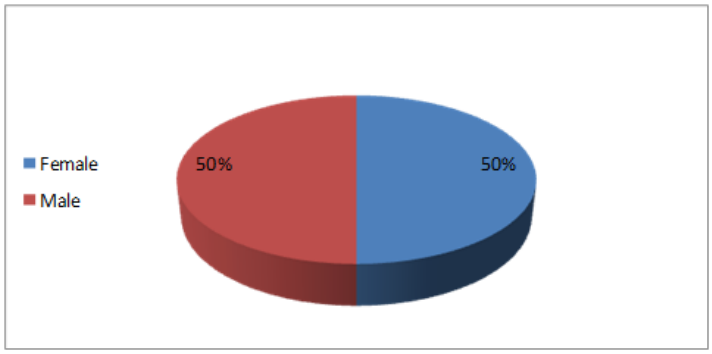

Figure 1: Distribution of the patients according to the gender.

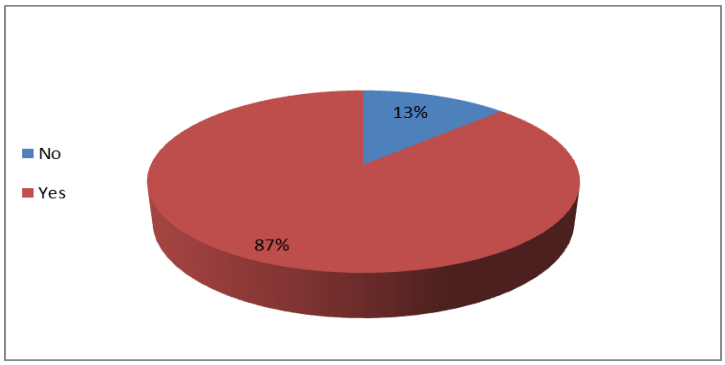

Figure 2: Distribution of the patients according to the recurrent infection.

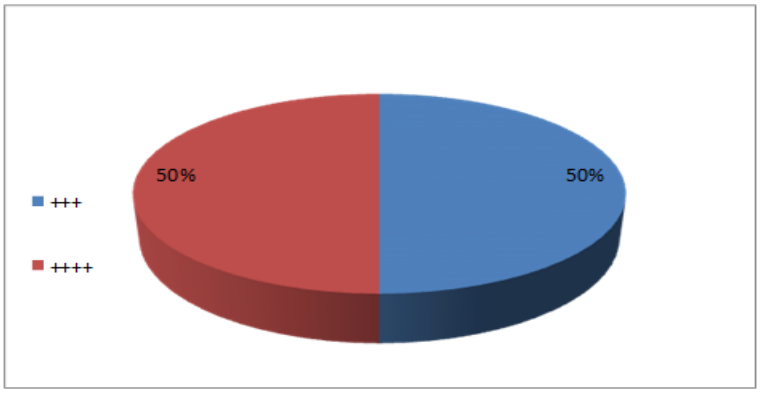

Figure 3: Distribution of the patients according to the degree of parasitemia.

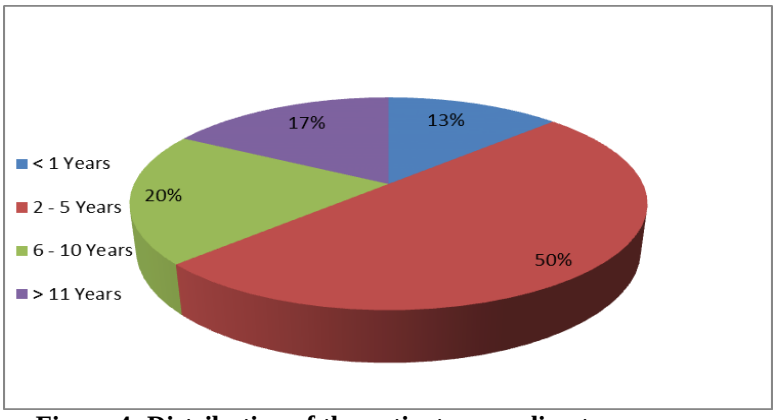

Figure 4: Distribution of the patients according to age groups.

Table 1: levels of serum Na in case and control groups.

Specimens	Number	Serum Na	SD	P-value
Case	30	130.93	6.52	0.000
Control	30	137.47	2.70	

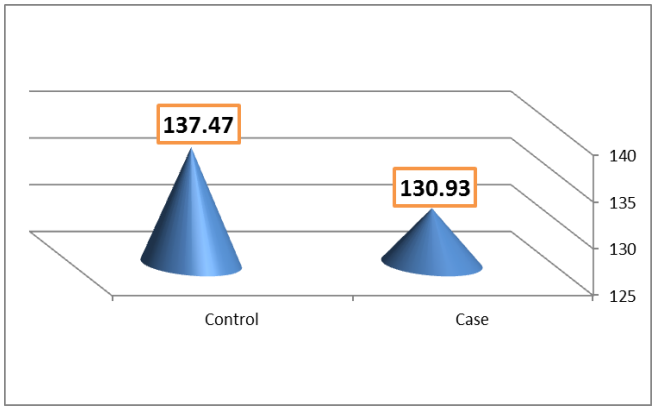

Figure 4.5 levels of serum Na in case and control groups.

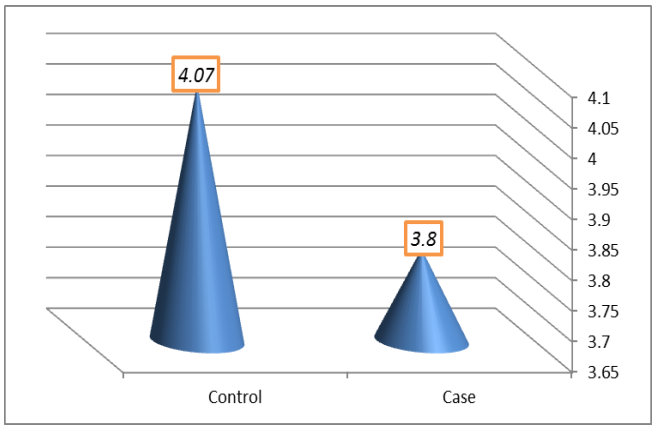

Figure 6: level of Serum K in case and control groups.

Table 3: Serum Na in the patients according to gender.

Gender	Number	Serum Na	SD	P-value
Male	15	130.27	4.7	0.466
Female	15	131.60	8.1	

Table 4: Serum K in the patients according to gender.

Gender	Number	Serum K	SD	P-value
Male	15	3.7	0.6	0.466
Female	15	3.9	0.5	

Table 5: Serum Na in patients with a degree of parasitemia.

	Number	Serum Na	SD	P-value
+++	15	128.33	4.7	0.002
++++	15	131.60	8.1	

Table 6: Serum K in patients with a degree of parasitemia.

	Number	Serum K	SD	P-value
+++	15	3.7	0.6	0.466
++++	15	3.9	0.5	

DISCUSSION

Malaria is the most parasitic disease of humans; it affects almost all organ systems but acute kidney and liver injury are the most complications of severe malaria. This is a case-control study that included 30 patients who have severe malaria and other 30 healthy individuals as a control group, carried out from May to August 2017 in Wad Medani Teaching Pediatric Hospital.

In the present study, the distribution of patients (30samples) according to gender was divided into 50 % females and 50% males. This study shows that 13% of patients haven't a recurrent infection and the other 87% have recurrent infection. Fifty percent of infected patients had hyperparasitemia (+++) and the other 50% had (++++). Severe malaria was found in 13% of patients those less than 1 year, in 50% from 2-5 years, in 20% from 6-10 years, and in 17% more than 11 years.

In the present study, we found low serum sodium and potassium level in cases when compared with controls with a significant difference, serum Na ± SD (130.93 ± 6.5) and in the control group (137.47 ± 2.70) with significant difference (P-value 0.000). Serum potassium was ± SD (3.80 ± 0.5) in cases and was (4.07 ± 0.6) in controls with a significant difference (P-value 0.041). This finding agrees with studies done in Sudan by Elsharif Ahmed Bazie; et al 2016, in Nigeria by Ebele J2010, and in Gzira State Sudan Zaki et al., 2013 and disagrees with the study done in Pakistan by Saira Baloch et al 2011. According to this study, the serum Na in was (130.27 ± 4.7) and (131.60 ± 8.1) in males and females respectively with no significant difference (P-value 0.466), while the mean of serum K was (3.7 ± 0.6), and (3.9 ± 0.5) in males and females respectively with no significant difference (P-value 0.466). Regarding gender this study relives no significant correlation between serum Na and K, this agrees with a study done in India by Jasmin et al., 2012 and a study that done in Iran by Asima et al., 2015 and in Nigeria by Uzuegbu, 2010 who found no significant correlation in serum potassium but there were significant in serum sodium.

Parasitemia (+++) and low serum Na (128.33 ± 4.7) were found in 15 patients, while patients have parasitemia (++++) and low serum Na (131.60 ± 8.1) were found in 15 patients with significance (P-value 0.002). Also, 15 patients have parasitemia (+++) and normal serum K (3.7 ± 0.6), and 15 patients have parasitemia (++++) and normal serum K (3.9 ± 0.5) with no significance (P-value 0.466). Regarding the degree of parasitemia, there was a significant correlation in serum sodium and a non-significant correlation with serum potassium, and this finding agrees with a study done in Nigeria by Ekeanyanwu, 2010.

CONCLUSION

This study was concluded that there is a significant decrease in serum sodium and potassium levels in patients with severe malaria.

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