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Effect of malaria on: Serum K, Serum Na and Blood urea- Sudan

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Abstract:

Malaria is life threatening disease, with nearly half of the world's population being vulnerable to this infection. Sodium (Na+) is the major cation of extra cellular fluid and as such plays a central role in the maintenance of the normal distribution of water and osmotic pressure in various fluid compartments. Potassium (K+) on the other hand is the major intracellular cation, having an average cellular concentration in tissue cells of 150mmol/L.

We studied 70 patients seen at the ER of Kosti teaching hospital from September to February 2016 .their mean age was 32.63 years old. Those with plasmodium falcipram were 68 patients (97.1%) and only two patients (2.9%) found to have p.vivax.

Simple malaria was found in 54 patients (77.1%) and sever malaria was found in 16 patients (22.9%). Those with low serum Na and low serum K were 7 patients (10%).

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The study draws attention to the need to manage electrolyte derangements in the overall management of malaria infections.

Key words: malaria; sodium; potassium; urea; Sudan

INTRODUCTION

Malaria is life threatening disease, with nearly half of the world's population being vulnerable to this infection [1]. Malaria accounts for an estimated 2-3 million deaths annually and it is also responsible for the untold morbidity in approximately 300 -500 million people annually [1]. Four species of Plasmodium 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 which result from malaria [2], which include cerebral malaria, anaemia and renal failure [3]

Sodium (Na+) is the major cation of extra cellular fluid and as such plays a central role in the maintenance of the normal distribution of water and osmotic pressure in various fluid compartments [4]. Potassium (K+) on the other hand is the major intracellular cation, having an average cellular concentration in tissue cells of 150mmol/L[5] (Kaplan *et al.,* 1995). In addition to water balance, these electrolytes play an important role in maintenance of pH, regulation of heart and muscle function, electron transfer reactions as well as serving as cofactors for enzymes[6]

Hyponatraemia, the decline in the Na concentration, is considered as an important clinical manifestation of malaria. Decreased level of Na exaggerates the disease symptoms and results in severe malaria [7].

Hypokalaemia is a common complication of severe malaria. Decreased level of K is an obvious correction of acidosis in malaria [8]

Prevalence of malaria is very high in Sudan. *P. falciparum* and *P. vivax* impart heavy health burdens on the local population of Sudan. Electrolyte imbalance appears because of malaria and may lead towards the severity of disease.

In human erythrocytes infected with the mature form of the malaria parasite, plasmodium falciparum, the cytosolic concentration of sodium ion is increased and that of potassium is decreased [9].

Kakkilaya [10] observed that malaria is often associated with abnormalities of fluid, electrolytes (sodium and potassium) and acid-base balance. These can occur in any body but are more common in severe falciparum malaria, extremes of age and in patients with high degree of fever and vomiting.

The present study aimed to find out the levels of Na, K, and blood urea in malarial patients suffering from both *P. vivax* and *P. falciparum*.

METHODS

The malaria parasite density was determined by examining a thick blood film stained by Giemsa method[11]

Classification of the degree of parasitaemia: The malaria parasite density was graded as follows:[11]

- 1 parasite/field: low density (+)-simple malaria
- 2-9 parasites/field: medium density (++)-simple malaria
- More than 20 parasites/field: high density –sever malaria

Serum sodium and potassium analysis:
The sodium and potassium in the samples were analyzed using flame emission spectrophotometric method [12]

Serum urea was determined by the Fearon reaction method (DiGiorgio,1974) in which urea react with diaceyl

monoxime to form yellow diazine derivative. The intensity of the colour measured at 520 nm was directly proportional to the concentration of urea in the sample.

RESULT

We studied 70 patients seen at the ER of Kosti teaching hospital from September to February 2016 .their mean age was 32.63 years old and minimum age was 1 years old and maximum age was 75 years old. (Std.Deviation=17.97)

Those less than 20 years old were 21 patients (30%), 20__40 years old were (38.6%) and >40 years old were 22 patients (31.4%). Table 1

In the study group females were 44 patients (62.9%) and males were 26 patients (37.1%). Table 2

Those with plasmodium falcipram were 68 patients (97.1%) and only two patients(2.9%) found to have p.vivax. Table 3

Simple malaria was found in 54 patients (77.1%) and sever malaria was found in 16 patients (22.9%). Table 4

In the study low serum sodium was found in 18 patients (25.7%) and normal serum sodium was found in 52 patients (74.3%). Table 5.

Normal serum potassium was found in 58 patients (82.9%) and low serum potassium was found in 12 patients (17.1%).Table 6.

In table 7; simple malaria was found mainly in those more than 40 years old(30%) , 25.7% with simple malaria and were between 20—40 years old and 21.4% were less than 20 years old and had simple malaria. Those with sever malaria and their age between 20---40 years old were 9 patients(12.9%), 6 patients (8.6%) with sever malaria and their age was less than 20 years old and only one patient(1.4%) with sever

malaria and he was more than 40 years old. With significant P.value=0.04

In table 8; those with sever malaria and low serum potassium were 3 patients (4.3%.), where those with sever malaria and normal serum potassium were 13 patients(18.6%). Simple malaria and low serum potassium was found in 9 patients(12.9%) and simple malaria with normal serum potassium was found in 45 patients (64.3%)p.value=0.000

In table 9; those who presented with sever malaria and low serum sodium were 7 patients(10%) and sever malaria with normal serum sodium were 9 patients(12.9%). Those with simple malaria and normal serum sodium were 43 patients(61.4%) and simple malaria with low serum sodium were 11 patients(15.7%).p.value=0.000

In table 11: those with low serum Na and low serum K were 7 patients (10%).

In table10: renal impairment with sever malaria was found in 6 patients(8.6%) and renal impairment with simple malaria was found in 12 patients (17.1%). Those with sever malaria and normal renal function was found in 10 patients(14.3%) and those with simple malaria and normal renal function was found in 42 patients(60%) p.value =0.219

Table 1 Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 20years	21	30.0	30.0	30.0
	20__40 years	27	38.6	38.6	68.6
	more than 40years	22	31.4	31.4	100.0
	Total	70	100.0	100.0	

Table 2 Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	26	37.1	37.1	37.1
	female	44	62.9	62.9	100.0
	Total	70	100.0	100.0	

Table 3 malaria species

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	P.Falcipram	68	97.1	97.1	97.1
	P.Vivax	2	2.9	2.9	100.0
	Total	70	100.0	100.0	

Table 4 severity of malaria

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	simple malaria	54	77.1	77.1	77.1
	sever malaria	16	22.9	22.9	100.0
	Total	70	100.0	100.0	

Table 5 serum Na

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	normal	52	74.3	74.3	74.3
	low	18	25.7	25.7	100.0
	Total	70	100.0	100.0	

Table 6 serum K

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	normal	58	82.9	82.9	82.9
	Low	12	17.1	17.1	100.0
	Total	70	100.0	100.0	

Table 7 Age & parasitemia correlation P.value=0.04

			parasitemia		
			simple malaria	sever malaria	Total
age	less than 20years	Count	15	6	21
		% of Total	21.4%	8.6%	30.0%
	20__40 years	Count	18	9	27
		% of Total	25.7%	12.9%	38.6%
	more than 40years	Count	21	1	22
		% of Total	30.0%	1.4%	31.4%
Total		Count	54	16	70
		% of Total	77.1%	22.9%	100.0%

Table 8 S.K & parasitemia

			parasitemia		
			simple malaria	sever malaria	Total
sK	normal	Count	45	13	58
		% of Total	64.3%	18.6%	82.9%
	Low	Count	9	3	12
		% of Total	12.9%	4.3%	17.1%
Total		Count	54	16	70
		% of Total	77.1%	22.9%	100.0%

Table 9 S.Na & parasitemia

			parasitemia		
			simple malaria	sever malaria	Total
sNa	normal	Count	43	9	52
		% of Total	61.4%	12.9%	74.3%
	low	Count	11	7	18
		% of Total	15.7%	10.0%	25.7%
Total		Count	54	16	70
		% of Total	77.1%	22.9%	100.0%

Table 10 RFT & parasitemia

			parasitemia		
			simple malaria	sever malaria	Total
RFT	normal	Count	42	10	52
		% of Total	60.0%	14.3%	74.3%
	impaired	Count	12	6	18
		% of Total	17.1%	8.6%	25.7%
Total		Count	54	16	70
		% of Total	77.1%	22.9%	100.0%

Table 11 S.K & S.Na Crosstabulation

			sNa		
			normal	low	Total
sK	normal	Count	47	11	58
		% of Total	67.1%	15.7%	82.9%
	Low	Count	5	7	12
		% of Total	7.1%	10.0%	17.1%
Total		Count	52	18	70
		% of Total	74.3%	25.7%	100.0%

Discussion

Malaria is a major cause of mortality and morbidity in the tropical regions in the world. An estimated 300-500 million

persons suffer from malaria every year and more than 1 million die each year [13]. P.Falciparum is the species which is most commonly associated with the severe and complicated forms of this disease[14]

We studied 70 patients who were diagnosed as malaria in which most of them were found to have plasmodium falcipram (P.F) 97.1% and the remaining had plasmodium vivax (P.V). In White Nile state P.F is the main causes of simple and sever malaria.

In our study the main age grouped affected with malaria were those between 20 and 40 years old , females were affected more than males(62.9%) &(37.1%) respectively, this result unlike that done in India by **Karunakar Das et al** [15] which showed 35% are female which may be due to female subjects stay for maximum time in house, better clothed, less frequent visit to endemic area. So relatively protected from mosquito bites (Park, 2007). In our community males with simple malaria symptoms usually treated at nearby health centers and they did not came to hospitals.

We found those with sever malaria and low serum sodium were 10% where simple malaria with low serum sodium were 15.7%.p.value=0.000.This because most of patients with symptoms of malaria cames to hospital to confirm the diagnosis especially in children and females.

Karrunakar et al [15] found in their study 13.3% had hyponatremia. Out of these, 5 patients (62%) had mild hyponatremia and 3 patients (38%) had severe hyponatremia. This may be due to hypovolemia following vomiting, decrease intake either orally or through nasogastric tube in unconscious patients.

Ikekpeazu et al. also observed reduction in the Na level of malaria patients[16]. Hyponatraemia has been reported to occur frequently in patients suffering from *P. falciparum*

malaria than in *P.vivax* malaria [17,18] and this finding is in line with our findings.

Potassium (K) is an important electrolyte in human body. It is also known as mineral of the heart because it directly affects the heart muscle cells.

In our study those with sever malaria and low serum potassium were 3 patients(4.3%.) and Simple malaria with low serum potassium was found in 9 patients(12.9%) so we found 17.1% with low serum potassium . Heindricks et al reported that the reduction in the K+ levels was because the host cells lost up to 75 to 80 % of their normal potassium content during the course of the malaria attack[19] .Dworak et al [20] stated that there is a progressive decrease in Na and K in 12 hrs of the parasite's occupancy whereas Kakkilaya [21] reported a mild hyponatraemia in malaria patients. Both findings are in line with the reductions observed in our study. The reason for the decrease in K+ level might also be linked with the statements of Heindricks et al[22] who reported that host cells loose up to 75-80% of their normal potassium content during the course of malaria attack..

Decline in the level of K has been reported in various studies [23,24]. Enhanced urinary removal of K and hypokalemia has been reported as common outcomes of malaria [25].

We found in our study 10% of patients both low serum Na and K and it was significant finding and this result is similar to **Ebele J Ikekpeazu** et al [26]study which showed significant decrease in Na+ and K+ levels in malaria infection. The reason for this is not fully known.

In our study renal impairment with sever malaria was found in (8.6%) of patients and renal impairment with simple malaria was found in (17.1%).**The main causes for renal impairment during malaria is prerenal causes like vomiting , diarrhea and decreases fluid intake.**

CONCLUSION

The study draws attention to the need to manage electrolyte derangements in the overall management of malaria infections. In general, serum electrolytes should be estimated in malaria patients of all ages to prevent complications which might result from electrolyte depletion, as these may have grave consequences.

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