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Serum Electrolytes and Urea Changes in *P. falciparum* Malarial Infected Children in Nigeria

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Abstract: Malaria associated renal impairment has remained scarce in our society. Therefore, in this present study, serum electrolytes' level and urea concentration were determined as selected renal function biomarkers in 71 malaria infected children between 0-5years receiving treatment. 67 age-matched children in apparent good health were included as control subjects. Data obtained show significant ($p<0.05$) increase in serum sodium and urea levels among female infected children when compared with gender-matched control but there was no demonstrated correlation between malarial parasitaemia and the changes in serum sodium or urea. Evidence indicate mild renal impairment among the malaria infected (female) children. However, it is not conclusive whether the impairment is due to the parasitaemia. Further studies are required to document the true malaria-associated renal dysfunction.

Key words: Electrolytes, kidney, malaria, parasitaemia, urea

INTRODUCTION

Malaria is a life threatening disease with nearly half of the world population being vulnerable to infection (Hay *et al*., *2004*). Malaria accounts for an estimated 2-3 million deaths annually (Andrey *et al*., 2003). Malaria is caused by *Plasmodium*, which is transmitted by mosquitoes. Four species *Plasmodium* causes malaria in humans. These are *P. falciparum*, *P. ovale*, *P. malariae* and *P. vivax*. *P. falciparum* is responsible for most deaths and most of the severe complications (Boonpucknaviq and Sitpnja, 1997), including cerebral malaria, anaemia and renal failure (David *et al.*, 1992).

Serious cases of renal problems associated with malaria take the form of nephrotic syndrome which gradually progress to renal failure. Renal failure is characterised by severe proteinuria, rise in blood urea, low ratio of urinary to blood urea, hyperkalaemia and metabolic acidosis. Assessment of renal function occurs in 1-5% of cases with mortality of 15-40% (Marshal *et al*., 2008).

Considering the endemicity of malaria in Nigeria, the mortality rate across families, particularly in children, accurate progress and proper management are very necessary. The incidence of kidney problems is on the increase in Nigeria. Malaria and other infectious diseases may be contributing factors. It is therefore important to know the prevalence level of renal involvement in malaria cases to ensure effective management of the patients.

Common electrolytes that are usually measured in relation to renal function include: sodium, potassium, bicarbonate and chloride. Urea, the major waste product of the breakdown of protein and other nitrogen containing compounds, excreted by the kidney via urine is also estimated.

The observed evidence of impairment of renal function in malaria is very important because Nigeria is an endemic country. Malaria has been recognised as one of the causes of acute renal failure in children in developing countries (Mockenhaupt *et al.*, 2004). Consequently, this study reports the changes in serum electrolytes and urea levels of malaria patients as means of ascertaining their renal function.

MATERIALS AND METHODS

Study centre and period: This study was conducted in the Malarial Research Unit, Department of Medical Biochemistry, Delta State University, Abraka, Nigeria, between May and November, 2009.

Subjects: Seventy- one malaria infected children between 0-5 years and who were receiving treatment in Federal Medical Centre, Owerri, were selected for this study. Sixty-seven control samples were obtained from age-matched children in apparent good health and without malaria infection. Verbal consent was obtained from the subjects' mothers. The patients were confirmed to have malaria by detection of malaria parasites in the blood smears prepared for their blood samples.

Collection of blood specimen: About 5 mL of blood sample was collected from each subject by vein puncture technique using 21 gauge hypodermic needle and syringe. The blood sample was collected into plain tube and allowed to clot. It was centrifuged at 1200 g for 5 min at

Table 1: Changes in serum electrolytes and urea levels in children (0-5years) with or without malaria infection

	Children with malaria		Children without malaria	
	Male (n = 35)	Famale (N = 36)	Male (n = 34)	Famale (n = 33)
Sodium (mmol/L)	131.5±6.2	133.6±7.3*	129.5±8.3	126±9.1
Potassium (mmol/L)	4.2±0.8	4.1±0.6	4.4±1.1	4.2±0.8
Bicarbonate (mmol/L)	28.8±3.6	27.1±3.2	26.5±2.6	26.4±3.0
Chloride (mmol/L)	99.4±10.2	103.8±5.1	106±6.3	107.3±68
Urea (mmol/L)	4.4±0.7	5.5±1.0*	5.0±1.2	4.9±0.9

Values are written as mean S.D. for 'n' subjects

*: Significantly different from comparable control values ($p<0.05$)

Reference ranges (mmol/L) for Na^+, K^+, HCO^-_3 and Cl^- and Urea are: 135-150, 3.5-5.2, 22.0-31.0, 97-108 and 3.0-6.6, respectively.

room temperature. Serum was separated into a bijou bottle using a pipette.

The serum in the bijou bottle was stored frozen until required for analysis.

Analysis of specimen: The serum electrolytes (Na^+, K^+, HCO^-_3 and Cl^-) levels and urea concentration were determined by standard kit procedure (Cheesbrough, 1991)

Statistics: The data obtained were analysed by the analysis of variance (ANOVA) and post-hoc comparison of mean values. The statistical significance was established at 5% probability level ($\alpha = 0.05$).

RESULTS AND DISCUSSION

The results obtained from the investigation are shown in Table 1. For sodium, there was no significant difference ($p<0.05$) between the levels in male malaria infected children and individuals without malaria. However, in females, there was significant, increase ($p<0.05$) in sodium levels in serum of malaria infected children when compared with control value.

For all other values, there were no significant difference ($p<0.05$), except the urea value for the female children infected without malaria.

Malaria has been recognised as one of the causes of acute renal failure especially among children in developing countries (Mockenhaupt *et al*., 2004). This observed evidence of renal function impairment in malaria is very important because Nigeria is an endemic country, and more so, quite a large number of the population still do not have access adequate health care. Even if they do, most patients report at hospitals only when self – medications have failed. There is therefore, predicted potential danger of widespread acute renal failure, which may in some cases progress to chronic kidney disease and the attendant mortality. , nevertheless, the relationship between malaria infection and renal function appears complicated and conflicting. In another report, *falciparum* malaria is not associated with remarkable disturbance in electrolyte balance (Boonpucknaviq and Sitpnja, 1997) and this study agrees with this earlier report. The elevated serum and urea levels in female malaria infected patients which differed significantly from the non-malaria individuals, may be primarily due to factors other than malaria infection as there was no positive correlation between parasitaemia and sodium or urea level.

The present study may not be conclusive. There is need for further investigation in order to establish the true picture of malaria-associated kidney dysfunction.

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