Full Length Research Paper

Haematological changes in children with malaria infection in Nigeria

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Haematological parameters are measurable indices of the blood that serve as a marker for disease diagnosis. The aim of this study was to evaluate haematological parameters of children with malaria in Nigeria. This was a prospective study in which the full blood count of children, aged 1 to 10 years, with malaria attending the Paediatric Clinic of the University of Port Harcourt Teaching Hospital, Nigeria from March to May 2007, were analysed. Data was analyzed using SPSS version 15.0 software. P value of less than or equal to 0.05 is considered as statistically significant. A total of 100 children were recruited for the study. Fifty children had *P.falciparum* malaria while the remaining was negative and were used as controls. There were more males with malaria (n=30) than females (n=20) and thirty two (64%) were below 5years while 18(36%) were above 5 years. Lymphocyte and monocyte counts were elevated among children with malaria relative to the control while haemoglobin and platelet levels were significantly decreased (P ≤0.05). The platelet level decreases as the degree of malaria parasitaemia increases. Haemalogical parameters in children with malaria infection are deranged. Thrombocytopenia could be used to determine presence and severity of malaria.

Keywords: Haemaological parameters, Malaria, Children.

INTRODUCTION

Malaria is one of the most prevalent human infections worldwide resulting in 225 million cases each year (WHO, 2010). It is caused by protozoa parasite of the genus plasmodium which infects and destroys red blood cells. Four species of plasmodia (P.falciparum, P.malariae, P.ovale and P.vivax) cause malaria in humans of which P.falciparum is the most common cause of morbidity and mortality (Taylor-Robinson, 1998; Das and Pan, 2006).

Malaria kills an average of 1 million children in Africa annually, Snow et al., (2005). In Nigeria about 96 million people are exposed to malaria, and out of these 64 million people get infected and almost 300,000 deaths are being reported annually in the general population, of which over 100,000 deaths are of children (Alaribe et al., 2006).

Haematological parameters are measurable indices of blood that serve as a marker for disease diagnosis (Petel et al., 2004). Haematological abnormalities such as anaemia and thrombocytopaenia have been observed in

patients with malaria (Ladhani et al. 2002; et al. 2007). The key feature of the biology of the Plasmodium falciparum, the predominant malaria species, is the ability of the infected red blood cells to adhere to the lining of the small blood vessels (Richard et al., 1998). Such sequestered parasites provide considerable obstruction to tissue perfusion. In addition, it is becoming clear that in severe malaria there may be marked reductions in the deformability of uninfected RBCs (Dondorp et al., 2000). RBCs destruction is an inevitable part of malaria, and anaemia further compromises oxygen delivery. Severe anaemia may arise from multiple poorly understood processes including acute haemolysis of uninfected RBCs and dyserythropoeisis, as well as through the interaction of malaria infection with other parasites infection and with nutritional deficiencies (Dondorp et al., 2000).

The aim of this study was to determine changes in the haematological parameters of children with malaria infection in Nigerian population of Africa. Alterations in the haematological indices may strengthen the suspicion of malaria, prompting more meticulous search for malaria parasite, and timely institution of specific therapy.

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Table1. Mean Value of Haematological Parameters of Children with Malaria and Control Subjects

Parameters (Reference range)	With Malaria (n=50)	Without Malaria (n=50)	P-Value
Hb(g/dl) (13-18)	8.7±0.0	10.7±1.4	<0.05
PCV (%) (42-16)	25.4±1.1	30.7±0.9	<0.05
WBC (x109/L) (4.3-10.5)	5.7±0.3	8.4±4.7	<0.05
Neutrophil (%) (45-74)	52.0±0.8	57.4±3.5	<0.05
Lymphocyte (%) (20-45)	47.6±0.0	40.6±4.0	<0.05
Monocyte (%) (4-10)	1.9±0.0	0.6±0.4	<0.05
Eosinophil (%) (0-7)	1.2±0.0	1.2±0.3	>0.05
Platelet(x109/L)(150-350)	143±0.1	245±0.2	<0.05

Key: Hb- Haemoglobin. PCV- Packed cell volume, WBC- White blood cell

MATERIALS AND METHODS

Selection of subjects: This was a prospective study involving children (from 1year to 10 years) with malaria parasitaemia in which the full blood count is compared with children without malaria parasitaemia(control) at the Paediatric Clinic of the University of Port Harcourt Teaching Hospital (UPTH), Nigeria from March to May 2007. Those with concomitant illnesses such as bronchopneumonia and sickle cell anaemia were excluded from the study. Children who satisfied the inclusion criteria were enrolled after informed consent from parents/guardians. Ethical approval was obtained from Ethics Committee of the UPTH.

Collection of blood sample: A standard clean venepuncture technique was used to collect 5mls of blood into a dipotassium EDTA bottles and samples were analysed within 24 hours of collection.

Laboratory assessment of hematological parameters/malaria parasite: All the haematological parameters were carried out by manual methods as described by Bain (1996). Haemoglobin concentration was determined by the cyanmethaemoglobin method as described by Babara and Bates (2001) , packed cell volume by microhaemotocrit method while white blood cell (WBC) count and differentials were estimated using the method of Dacie and Lewis (1991).

Platelet count was performed using the International Committee on Standards in Hematology (ICSH) approved procedures (Jeremiah and Oburu 2010). Platelets were counted under the microscope using the improved Neubaeur counting chamber. Results were expressed as platelet × 109/L. As a quality control measure, a thin smear of each sample was made and stained with Giemsa stain. The Giemsa-stained film was examined under the light microscope to rule out platelet clumps and to ensure that the platelets were spread evenly before the actual count was done by a trained biomedical scientist/hematologist.

Malarial parasite was detected using the quantitative buffy coat (QBC) technique as developed by Becton-Dickinson. Species were identified by thick blood film microscopic examination. QBC is a relatively new method of identifying the malaria parasite in peripheral blood. The key features of the method are centrifugation and staining of centrifuged and compressed cell layer with acridine orange in a predictable area of the QBC tube and its examination under ultraviolet (UV) light source. Parasite diagnosis by QBC method is more sensitive than the conventional thick blood film microscopic examination method due, in part, to comparatively larger volume of blood screened for parasitic infection and the ability to concentrate the parasite into a narrow zone of the tube.

The level of malaria parasitaemia is quantified using the "plus system": += < 1 parasite per QBC field, ++= 1-10 parasites per QBC field, +++= 11-100 parasites per QBC field, ++++ = >100 parasites per QBC field.

Anaemia was defined as haemoglobin level <13g/dl for both males and females while thrombocytopenia is platelet count <150 x 10^3/µL.

Statistical analysis: Descriptive statistics of continuous variables were expressed in mean using the Statistical Package for Social Sciences (version 15; SPSSInc, Chicago, IL).Continuous variables were compared using the Student's t- test and P value ≤ 0.05 is considered as statistically significant.

RESULTS

A total of 100 children were recruited for the study. Fifty children had *P.falciparum* malaria while the remaining were negative and were used as controls. There were 30 males and 20 females giving a male: female ratio of 1:1.5. Of the children with malaria 32 (64%) were below 5 years while 18 (36%) were above 5 years. Table 1 shows the mean value of the haematological parameters in patients and control subjects. There was significant reduction in the haemoglobin and platelet levels in children with malaria compared to the control (P≤ 0.05). Neutrophil level in the subjects with malaria was lower than the control (P> 0.05). The mean monocyte count was low in subjects with malaria but higher when compared with the control (P≤ 0.05). Table 2 shows progressive decrease in the platelet count with the

Table 2. Mean Value of Haematological Parameters Associated with Different Levels of Malaria Parasitaemia

Parameters	MP+(Mean±SD)	MP++(Mean±SD)	MP+++(Mean±SD)	P-Value
Hb(g/dl)	8.8±0.1	8.6±0.1	9.3±0.1	>0.05
PCV(%)	24.9±0.0	24.6±0.1	25.5±0.1	>0.05
WBC(x109/L)	5.2±0.2	6.6±0.0	6.35±0.2	>0.05
Neutophil(%)	49.5±0.4	53.7±0.3	62.0±0.1	>0.05
Lymphocyte(%)	38±0.1	36.7±0.1	38.0±0.1	>0.05
Monocyte(%)	1.5±0.6	2.7±0.9	2.5±0.4	>0.05
Eosinophil(%)	1.2±0.2	1.3±0.4	3.0±0.4	>0.05
Platelet(x109/L)	198.6±0.1	132.6±0.0	108±0.1	<0.05

Key: Hb- Haemoglobin. PCV- Packed cell volume, MP- Malarial parasite

severity of malaria (P≤ 0.05).

DISCUSSION

Malaria infection remains a serious health problem in sub-Saharan Africa including Nigeria (Ekanem, 1991; Dzeing-Ella et al. 2005). We found significant reduction in the haemoglobin concentration in children with malaria parasitaemia compared to controls and our findings is similar to an earlier finding (Ho and White, 1999). High levels of parasitaemia particularly with *P.falciparum* cause more destruction of red blood cells hence reducing haemoglobin levels leading to anaemia. This may be as a result of haemolysis of parasitized red blood cells, accelerated removal of parasitized red blood cells and ineffective erythropoiesis (Bashawri et al., 2002).

There was a significantly reduced mean total white blood cell (WBC) count among the children with malaria infection than the control in this study. Our finding is in consonance with reports of Ho and white. However, recently an Indian study found leucocytosis in malaria-infected children which is at variance with our finding (Maina et al. 2010) which found normal values. Furthermore, white blood cell differentials like lymphocyte and neutrophils were normal in children with malaria and control. Although, significantly lower values were observed among children with malaria than the control. Nonetheless, monocyte count of children with malaria in our study was low, but higher than the control (P<0.05). Phagocytosis of malaria pigment by monocytes may be responsible for the relatively higher figures in the malaria-infected subjects than the control.   Low levels of monocytes and lymphocyte in malaria had been reported previously (Erhart et al., 2004).

Thrombocytopenia is a common feature of acute malaria and occurs in both *P. falciparum* and *P. vivax* infections regardless of the severity of infection (Akhtar et al.2005). The absence of the normal quantity of platelets on a peripheral smear in a case of fever is often a clue to the presence of malaria (Mahmood and Yasir, 2005). In this study the mean platelet count was significantly lower than those of the control subjects. This is similar to previous reports (Chen et al., 2000; Imbert, 2003). The relative thrombocytopenia may be due to sequestration and pooling of the platelets in the spleen.   Imbert and colleagues in 2003 reported that thrombocytopenia should be considered to be an important predictor of severity in childhood falciparum malaria as seen also in our study which demonstrated progressive decrease in the level of platelet with malaria severity. Petel et al (2004) observed that thrombocytopenia could be an important diagnostic clue for malaria in endemic areas while Snow et al. (2005) admitted that severe thrombocytopenia (<50x109/L) is rare in malaria.

CONCLUSION

In conclusion, malaria infection is an important factor that alters haematological indices in children in Nigeria. Presence of thrombocytopenia in a patient with acute febrile illness in the tropics increases the probability of malaria and enhances prompt initiation of treatment. Also the degree of thrombocytopenia may be a useful tool in the determination of severity of malaria infection in the tropics.

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