

Changes in White Blood Cells Differential associated with adult Malaria-infected Patients

ABSTRACT

Aims: Malaria parasites are expected to impact the white blood cell differentials of malaria patients but reports on changes in white blood cell differentials of malaria patients are not well documented, hence this study was undertaken to determine changes in white blood cell differentials associated with male and female malaria patients.

Study design: Twenty male and twenty female malaria patients were divided into four groups made up of ten malaria positive males (MPM), ten malaria negative males (MNM), ten malaria positive females (MPF) and ten malaria negative females (MNF).

Methodology: The hematological parameters were evaluated using automated full blood count Sysmex machine.

Results: The result of changes in white blood cell differential associated with male and female malaria patients showed an increase in lymphocyte percentage (LYM%), mixed cell count percentage (MXD%), neutrophil percentage (NEU%), lymphocyte absolute value (LYM#), mixed cell count absolute value (MXD#) and neutrophil absolute value (NEU#) of both malaria positive males and females compared to malaria negative males and females ($P < 0.05$).

Conclusion: This study has shown that malaria parasite increased significantly all white blood cell differential parameters in male and female patients examined. White blood cell differential in adult malaria-infected patients are associated with increase in white blood cell differential parameters irrespective of gender. Further studies should be carried out to determine the clinical relevance of this finding especially as it could assist in the diagnosis of malaria infection.

Keywords: White Blood Cell Differential, Malaria, Adult, Changes

1.INTRODUCTION

Haematological parameters are measurable indices of blood that serve as a marker for disease diagnosis [1]. Haematological abnormalities such as anaemia and thrombocytopaenia have been observed in patients with malaria [2,3]. In spite of intensive worldwide efforts to reduce its transmission, malaria remains the most serious and widespread protozoan infection of humans. Over 40% of the world's population is at risk of contracting the disease, which is endemic in 91 countries, mostly developing ones. Almost all cases of malaria are caused by four species of the genus *Plasmodium* – namely *vivax*, *falciparum*, *malariae*, and *ovale*. Malaria infection imposes a great socio-economic burden on humanity, accounting for 85% of global infectious disease

burden along with other diseases [4]. Approximately 1.2 billion people live in areas of high risk and 2.1 billion in low-risk areas and each year, there are nearly 247 million cases and 1 million deaths.

In Nigeria, there are over 100 million people at risk of malaria every year and it is estimated that about 50 % of the adult population experience at least one episode yearly [5]. 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 reported annually in the general population, of which over 100,000 deaths are attributed to children [6]. Malaria causes a lot of debilitating effect in adults and the economic loss due to malaria in Nigeria has been put at 132 billion Naira comprising cost of treatment and transport to source of treatment, loss of man-hours, absenteeism from places of work and other indirect costs [5]. Malaria remains a major health concern worldwide, causing 216 million infections and approximately 655,000 deaths in the year 2010 [7]. About 91 percent of malaria-related deaths are in Africa with 86 percent of victims being children aged under 5years [8]. Malaria is responsible for a significant number of deaths in endemic countries particularly in sub-saharan Africa [9, 10]. It is one of the three killers among communicable diseases in Africa [11]. Hematological changes in the course of a malaria infection, such as anemia, thrombocytopenia and leukocytosis or leucopenia are well recognized. These alterations vary with the level of malarial endemicity, background hemoglobinopathy, nutritional status, demographic factors and also malaria immunity [12, 13, 14]. Haematological changes are some of the most common complications in malaria and they play a major role in malaria pathology [15, 16]. These changes involve the major cell lines such as red blood cells, leucocytes and thrombocytes [17, 18]. There appear to be a paucity of data on the changes in white blood

cell differentials associated with adult malaria patients hence the aim of this study is to determine changes in white blood cell differential associated with adult- malaria patients.

2. MATERIALS AND METHODS

2.1 Sample Collection

The study was carried out in the laboratory of the Living Word Mission Hospital Aba, Abia State, Nigeria. Oral consent was obtained from all patients. Thick and thin Giemsa stained blood films were made on a slide from 2ml of venous 100 blood samples collected and viewed under a light microscope. Forty (40) samples were selected by simple random sampling of patients aged between 21 to 60 years made up of four experimental groups which included ten (10) malaria positive males (MPM), ten (10) malaria negative males (MNM), ten (10) malaria positive females (MPF) and ten (10) malaria negative females (MNF). The blood from each experimental group was collected into Ethylene diamine-tetra-acetic acid (EDTA) bottle for laboratory investigations to perform full blood count. Patients suffering from malnutrition, hepatitis, smokers, HIV/AIDS patients, those on anti-malaria drugs, typhoid fever, dengue fever and meningitis patients were excluded from the study 

2.2 Evaluation of White Blood Cell Differential Parameters

White blood cell differential parameters such as lymphocyte percentage (LYM%), mixed cell count percentage (MXD%), neutrophil percentage (NEU%), lymphocyte absolute value (LYM#), mixed cell count absolute value (MXD#) and neutrophil absolute value (NEU#) were determined with automated haematological analyzer Sysmex-KX-21N which provided a high level of accuracy through the use of automatic floating discriminators.

2.3 Statistical Analysis

The data collected were pooled and analyzed for their central tendencies using descriptive statistics, values were given as mean $\pm$ standard deviation of 10 observations. ANOVA and LSD were employed to test the significant differences ($p < 0.05$) among treatment means. All analysis was performed using SPSS for windows statistical software package version 20. The resulting outputs were presented in tables.

3. RESULTS

3.1 Changes in White Blood Cell Differential Associated with Male Malaria Patients

The changes in White Blood Cell differential associated with male malaria patients showed that lymphocyte percentage (LYM%) was increased from (29.0 ± 5.44) to (56 ± 6.50) and the difference was statistically significant at ($p < 0.05$) (Table 1). Similarly, mixed cell count percentage (MXD%) and neutrophil percentage (NEU%) were increased from (16.64 ± 3.26) to (35.04 ± 7.08) and 51.50 ± 8.38 to (83.30 ± 4.77) respectively, both differences were statistically significant at ($p < 0.05$) (Table 1). Furthermore, lymphocyte absolute value, (LYM#), mixed cell count absolute value (MXD#), and neutrophil absolute value (NEU#) were increased from (1.59 ± 0.54) to (5.19 ± 2.04) , (-0.90 ± 0.40) to (3.20 ± 0.93) and (4.56 ± 0.86) to (10.06 ± 3.26) respectively, and these differences were statistically significant at ($p < 0.05$) (Table 1).

3.2 Changes in White Blood cell Differential Associated with Female Malaria Patients

The changes in White Blood Cell differential associated with female malaria patients showed that LYM % was increased from (33.33 ± 7.80) to (61.0 ± 10.59) and the difference was statistically significant at ($p < 0.05$) (Table 2). Similarly, MXD% and NEU% were increased from (13.94 ± 4.84) to (37.74 ± 6.67) and (53.66 ± 13.45) to (82.90 ± 4.23) respectively, both differences were statistically significant at ($p < 0.05$) (Table 2). Furthermore, LYM#, MXD# and NEU# were increased from (1.66 ± 0.55) to (5.09 ± 2.32) , $(0.98$

± 0.33) to (4.06 ± 3.26) and (4.33 ± 1.25) to (8.56 ± 1.51) respectively, and these differences were statistically significant at (p < 0.05) (Table 2).

Table 1: Changes in White Blood Cell Differential Associated with Male Malaria Patients

Haematological Parameters	Malaria Positive Males	Malaria Negative Males
LYM% (%)	56.0±6.50 ^a	29.0±5.44 ^b
MXD% (%)	35.04±7.08 ^a	16.64±3.26 ^b
NEU% (%)	83.30±4.77 ^a	51.50±8.38 ^b
LYM# (/ul)	5.19±2.04 ^a	1.59±0.54 ^b
MXD# (/ul)	3.20±0.93 ^a	0.90±0.40 ^b
NEU# (/ul)	10.06±3.26 ^a	4.56±0.86 ^b

Values are given as Mean ± Standard Deviation of 10 observations (N= 10). Mean values in the same row with different superscripts differ significantly (p < 0.05). KEY: LYM%= Lymphocyte Percentage, MXD%= Mixed Cell Count Percentage, NEU%= Neutrophil Percentage, LYM#= Lymphocyte Absolute Value, MXD#= Mixed Cell Count Absolute Value, NEU#= Neutrophil Absolute Value.

Table 2: Changes in White Blood Cell Differential Associated with Female Malaria Patients

Haematological Parameters	Malaria Positive Females	Malaria Negative Females
LYM% (%)	61.0±10.59 ^a	33.33±7.80 ^b
MXD% (%)	37.74±6.67 ^a	13.94±4.84 ^b
NEU% (%)	82.90±4.23 ^a	53.66±13.45 ^b
LYM# (/ul)	5.09±2.32 ^a	1.66±0.55 ^b
MXD# (/ul)	4.06±3.26 ^a	0.98±0.33 ^b
NEU# (/ul)	8.56±1.51 ^a	4.33±1.25 ^b

Values are given as Mean ± Standard Deviation of 10 observations (N= 10). Mean values in the same row with different superscripts differ significantly (p < 0.05). KEY: LYM%= Lymphocyte Percentage, MXD%= Mixed Cell Count Percentage, NEU%= Neutrophil Percentage, LYM#= Lymphocyte Absolute Value, MXD#= Mixed Cell Count Absolute Value, NEU#= Neutrophil Absolute Value.

DISCUSSION

Malaria is a disease of tropical and sub-tropical countries particularly Africa and Asia which has continued to cause significant morbidity and mortality worldwide. More than 40% of the world population reside in malaria-endemic area and it is projected that 300-500 million cases and 1.5-2.7 million deaths occur each year due to malaria [1]. Hematological changes are the most common complications of malaria and hematological abnormalities that have been reported in malaria include anemia, thrombocytopenia, atypical lymphocytosis, infrequently disseminated intravascular coagulation, Leucopenia, leucocytosis, Neutopenia, Neutrophilia, Eosinophilia and monocytosis [20, 21, 22]. The changes in white blood cell differential associated with male and female malaria patients showed a significant increase ($p < 0.05$) in lymphocyte percentage (LYM%), mixed cell count percentage (MXD%), neutrophil percentage (NEU%), lymphocyte absolute value (LYM#), mixed cell count absolute value (MXD#) and neutrophil absolute value (NEU #) of the malaria positive males compared to the malaria negative males. This result is in line with the reports of [23] and [24]. These works showed a significant increase in LYM%, NEU%, LYM# and NEU# respectively. The reason for the increase in these parameters may be as a result of the production of different kinds of white blood cells and antibodies to fight the impending infection or disease. In this study, significant increase in neutrophil level of individuals infected observed could be a representation of early release of neutrophil from the bone marrow response to the infection [24].

5. CONCLUSION

In conclusion, malaria infection is an important factor that causes changes in the white blood cell differential of adult. It can be safely concluded that malaria may not lead to leucopenia and immune deficiency in both males and females as it increased all white blood cell differential parameters studied. White blood cell differentials in adult malaria-infected patients are associated with increase in white blood cell differential parameters irrespective of gender.

Further studies should be carried out to determine the clinical relevance of this finding especially as it could assist in the diagnosis of malaria infection.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author have declared that no competing interests exist.

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