Impact of Acute Malaria on Some Haematological Parameters in
A Semi-Urban Community in Southwestern Nigeria

'C. Igbeneghu and A.B. Odaibo

1Department of Biomedical Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
2Department of Zoology, Parasitology Unit, University of Ibadan, Ibadan, Oyo State, Nigeria

Abstract: Malarial parasites are expected to induce haematological alterations but reports on changes in haematological parameters during malaria among adults in Southwest Nigeria are not well documented. To investigate the effect of acute malaria on some haematological indices, a sample of 5 ml of venous blood was drawn from each of 671 adults with acute malarial infection and 523 apparently healthy subjects in Iwo, Southwestern Nigeria, for examination of a full blood count. Malaria parasites detection was done by microscopic examination of thin and thick blood films stained with 3% Giemsa. Estimations of haematocrit, leucocyte, platelet, haemoglobin concentration and erythrocyte were made using an automated Coulter counter (STKS model). Participants with acute malaria had significantly lower (p < 0.05) mean values of haematocrit, leucocyte, platelet, haemoglobin concentration and erythrocyte count (33.7±4.8%, 3.7±1.2x10^9/L, 132.0±33.8x10^9/L, 117.2±16.0 g/L, 4.2±0.6x10^12/L) compared to the apparently healthy subjects (39.5±4.0%, 5.3±2.1x10^9/L, 163.2±29.5x10^9/L, 136.5±13.4x10^12/L, 5.0±0.6x10^12/L). Although, anaemia (OR = 7.1; CI = 5.5-9.2; p < 0.05), leucopenia (OR = 6.5; CI = 4.1-10.4; p < 0.05) and thrombocytopenia (OR = 10.5; CI = 4.1-10.4; p < 0.05) were all significantly associated with acute malaria, thrombocytopenia showed the strongest association. Thrombocytopenia was the strongest predictor of acute malaria infection among the study population.

Key words: Adults · Apparently Healthy Subjects · Malarial Patients · Haematological Parameters

INTRODUCTION

Adults living in malaria endemic areas are constantly attacked by malaria but this has been neglected [1]. Studies on malaria are generally focused on children who are less than 5 years and pregnant women who are susceptible to malaria related sickness and death [2]. Although malaria is more devastating in children and pregnant women due to less immunity or loss of immunity, it is still one of the most debilitating diseases among non-pregnant adults particularly those in rural areas where there is absence of quick intervention measures. 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 [3]. Malaria causes a lot of debilitating effect in adults and the yearly 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 cost [3].

As parasites of blood, Plasmodium spp. are expected to induce haematological alterations. Although some haematological changes associated with malaria are generally recognized, there are conflicting reports on variation in some haematological parameters. For instance, malaria has been associated with anaemia and non-anaemia, mild and severe thrombocytopenia, leucopenia and leucocytosis [4, 5]. Many of the recent studies involving haematological changes in malaria have been conducted on children with severe malaria [6, 7] and a few on adults of other races [4, 5].

In Nigeria, haematological changes associated with malaria infection in adults have not been well-documented. This study was carried out in this malaria endemic area to investigate the effect of malaria on some
haematological parameters in adults and to ascertain which of them increases the probability of acute malarial infection.

RESULTS

Table 1 showed the mean age and number of participants with respect to sex of the apparently healthy group and acute malarial group were not significantly different (p = 0.2, p = 0.1), while mean values of haematocrit, leucocyte, platelet, haemoglobin concentration and erythrocyte count of apparently healthy participants were significantly higher (p < 0.0001, p < 0.0001, p < 0.0001, p < 0.0001) than those with acute malaria.

The mean values of the examined haematological parameters of apparently healthy subjects and malarial subjects according to sex were given in Table 2. In addition, Table 2 showed published reference range values for the parameters as stated in Cheesbrough (2000). All the values of the apparently healthy subjects were within the acceptable normal limits. The mean values of haematocrit and haemoglobin concentration for apparently healthy males were significantly higher (p < 0.0001, p < 0.0001) than those of their female counterparts; their mean platelet count was significantly lower (p < 0.001) than that of females while the mean total leucocyte counts of females and males were not significantly different (p = 0.2).

On the other hand, all the values of the acute malarial subjects were lower than the lower limits of acceptable ranges. Nevertheless, as observed in apparently healthy subjects, the mean values of haematocrit and haemoglobin concentration for males with acute malaria were significantly higher (p < 0.0001, p < 0.0001) than those of their female counterparts; their mean platelet count was significantly lower (p < 0.001) than that of the females while the mean total leucocyte counts of females and males with acute malaria were not significantly different (p=0.15).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Apparently Healthy Subjects</th>
<th>Acute Malarial Subjects</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>671</td>
<td>523</td>
<td></td>
</tr>
<tr>
<td>Sex (male)</td>
<td>444 (66.2)</td>
<td>370 (70.7)</td>
<td>0.1</td>
</tr>
<tr>
<td>Age</td>
<td>33.2±12.0</td>
<td>32.6±11.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Haematocrit (%)</td>
<td>39.5±4.0</td>
<td>33.7±4.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total Leucocyte count (10³/µL)</td>
<td>5.3±2.1</td>
<td>3.7±1.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Platelet count (10³/µL)</td>
<td>163.2±29.5</td>
<td>132.3±33.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Haemoglobin conc. (g/L)</td>
<td>136.2±13.4</td>
<td>117.2±16.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Erythrocyte count (10¹²/µL)</td>
<td>5.0±0.6</td>
<td>4.2±0.6</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

MATERIALS AND METHODS

The study was carried out in Iwo, a semi-urban community in Southwestern Nigeria. It is situated between Latitudes 7°37´30½ and 7°38´30½N and Longitudes 4°10´30½ and 4°12´00½S. Two categories of subjects were studied. The first was consisted of 671 patients who had not taken any drug and were diagnosed of acute malaria at some health facilities in Iwo. Acute malaria was defined as fever or history of fever plus presence of parasitaemia. Fever was defined as axillary temperature = 37.5°C or a history of fever in the last 72 hours. The second category (control subjects) consisted of 523 apparently healthy individuals of the community with no clinical signs and symptoms of ill health as of the time of investigation. Participants were admitted into the study after clinical examination and informed consent. Ethical approval for this study was obtained from the Ethical Committee of Ladoke Akintola University Teaching Hospital, Osogbo, Osun State, Nigeria.

A sample of 5 ml of venous blood was collected once from each participant into Ethylene diamine tetra-acetic acid (EDTA) bottle for laboratory investigations. Malaria parasites detection was done by microscopic examination of thin and thick blood films stained with 3% Giemsa. Haematocrit, leucocyte count, platelet count, haemoglobin concentration and erythrocyte count, were estimated using an automated Coulter counter STKS model.

Statistical Analysis: Continuous variables were expressed as mean ± standard deviation (S.D). Parameters comparisons were done using Student’s t test. Odds ratio was used to test for association involving variables. A p-value of < 0.05 was considered significant.

Table 1: Base Line Characteristics of the Study Population
The mean values of haematocrit, leucocyte, platelet, haemoglobin concentration and erythrocyte count of apparently healthy males were significantly higher (p < 0.0001, p < 0.0001, p < 0.0001, p < 0.0001, p < 0.0001) than those of males with acute malaria. Similarly, the mean values of haematocrit, leucocyte, platelet, haemoglobin concentration and erythrocyte count of apparently healthy females were significantly higher (p < 0.0001, p < 0.0001, p < 0.0001, p < 0.0001, p < 0.0001) than those of females with acute malaria.

Categorical variables were created from haemoglobin concentration, leucocyte count and platelet count and tested for independent associations with malaria (Table 3). Anaemia (< 130 g/L and < 120 g/L for male and female respectively) (OR = 7.1; CI = 5.5-9.2; p < 0.05), low leucocyte count (< 2.6 x 10^9/L) (OR = 6.5; CI = 4.1-10.4; p < 0.05) and low platelet count (< 150 x 10^9/L) (OR = 10.5; CI = 8.1-13.6; p < 0.05) were all significantly associated with acute malaria. However, low platelet count showed the greatest independent association with malaria. A person with platelet count < 150 x 10^9/L was 10.5 times likely to have malaria than one with platelet count > 150 x 10^9/L.

**DISCUSSION**

The findings in this study showed that during acute malarial infection in adults, there were peripheral blood changes such as anaemia, leucopenia and thrombocytopenia. Severe cases of these conditions were however not observed. Anaemia was significantly associated with malaria in this study. Some studies among non-immune and semi-immune adult populations have also found statistically significant levels of mild anaemia.
in malarial patients [5, 10]. The impact of malaria on haemoglobin level appears high in regions of sub-Saharan Africa as a result of underlying anaemia and poor nutrition. In Eastern and Southeastern Asia where malaria is also endemic, only small degree of haemoglobin concentration change is associated with malaria because underlying anaemia and poor nutrition are not common [5, 9]. Anaemia in acute malaria is due to increase in haemolysis and decrease in the rate of production of red blood cells, increased destruction of parasitized red blood cells and accelerated removal of both parasitized and unparasitized red blood cells [11]. Other factors contributing to anaemia in malaria include increased red blood cell deformability, splenic phagocytosis and/or pooling [7].

Although low leucocyte count was associated with malarial infection in this study, leucopenia occurred in only 19.5% of the subjects with malaria while majority (79.7%) had counts within the reference range. The result of the leucocyte count is in line with those of Lee et al. [9] and Richard et al. [12] but different from that of (Rojanasthien et al. [13] who found no decrease in leucocyte count during malaria. Some studies have shown that leucopenia as a common finding in both non-immune and semi-immune malaria patients where leucocyte counts might be as low as 1-2x10^9/L [14, 15]. While leucopenia has been more associated with mild malaria, leucocytosis has been mainly implicated in severe malaria [16]. Leucopenia has been linked with depletion in the lymphocyte subsets through apoptosis [17] or due to sequestration of the cells in the lymph nodes or other body tissues [13]. Neutropenia has also been implicated involving such mechanisms as a shift in neutrophils from the circulatory to the marginal pool to sites of inflammation, splenic localisation, serum lymphotoxic factors and intercurrent bacterial infections [18].

In this study, low platelet count was associated with malaria. Thrombocytopenia has been associated with malaria [9, 10, 19] and severe cases of thrombocytopenia have been reported in some the studies [9, 13]. Although the mechanism of thrombocytopenia is not fully understood, it is thought to be due to peripheral destruction and consumption. Immune complexes generated by malaria antigen lead to sequestration of the injured platelets by macrophages in the spleen and platelet consumption in disseminated intravascular coagulation together with platelet dysfunction resulting in hyperaggregation are thought to contribute to thrombocytopenia in malaria [5].

**ACKNOWLEDGEMENTS**

We are grateful to the managements and staff of Bowen Baptist, Victory and the State Hospitals all in Iwo for their invaluable cooperation and support during the course of this study.

**REFERENCES**