

# Significance of White Blood Cell and Platelets Count in Malaria and their Correlation with various Morphological Forms of Plasmodia Species

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## ABSTRACT

**Objective:** To observe hematological variations in different types of malaria and severity of parasitemia caused by Plasmodium species.

**Study Design:** Cross sectional study.

**Pace and Duration of Study:** This study was conducted at the Department of Pathology, Isra University from January 2014 to June 2014.

**Materials and Methods:** The patients with clinical features suggestive of malaria and positive blood smear showing malarial parasite were included in the study. The blood for hematological parameters and thick and thin peripheral film preparation was collected in EDTA tubes. To observe the various morphological forms of plasmodium, peripheral blood films were stained with Leishman's stain. The WBC and platelet counts were determined using automated hematology analyser.

**Results:** Out of 96, Leukocytosis was noted in 16 (45%) and 35 (57.3%) of *P. falciparum* and *P. vivax* patients respectively. Thrombocytopenia was noted in 32 (91.4%) and 47 (77%) of *P.falciparum* and *P.vivax* patients respectively. Frequency of thrombocytopenia was more in *P.falciparum* patients compared to *P. vivax*. Ring forms and trophozoites in both *P.falciparum* and *P.vivax* were noted.

**Conclusion:** The present study revealed leukocytosis, leukopenia, leukocytic pigment and thrombocytopenia as the most common haematological findings among malaria patients.

**Key Words:** *P. falciparum*, *P. vivax*, Hematological changes, Peripheral blood smear.

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## INTRODUCTION

Malaria is one of the oldest scourges of human kind. It is a vector borne protozoan disease of mankind. The anopheles mosquito is the vector and Plasmodium is the transmitted protozoa<sup>1,2</sup>[29, 30]. Southeast Asia is over burdened with malaria with high incidence and prevalence in countries like Pakistan, Nepal, Sri Lanka, Indonesia, Bangladesh and India. According to a WHO estimate, the Pakistan lies in sub-tropical malarial zone according to incidence and prevalence. Geographical location, agricultural land, and monsoon rains contribute to malaria spread and persistence in Pakistan<sup>3</sup>.

Malaria patients are present in the tropical countries throughout year. However, seasonal variations of malaria incidence are a rule. Malaria incidence is very high in autumn and spring<sup>4</sup>.

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Blood abnormalities may occur in malaria due to disseminated intravascular coagulation (DIC) and thrombocytopenia<sup>5</sup>. Leukocyte counts may be low or normal in peripheral circulation. This occurs because of localization of white blood cells to peripheral organs like spleen and lymph nodes. Absolute reduction of leukocyte counts does never occur<sup>6</sup>.

Severe and complicated malaria may be defined by one or more grave signs and/or symptoms like; Cerebral malaria, Hematocrit <15%, Hemoglobin <5 g/dl, Hypoglycemia (plasma glucose <40 mg/dL), Circulatory shock, Renal failure, Black water fever, Thrombocytopenia, Respiratory distress syndrome, DIC, Pulmonary edema, Jaundice and Peripheral blood smear positive for malaria [8]. Gold standard method of diagnosing malaria is through staining of thick and thin blood films and watching for malaria parasite by light microscopy<sup>7</sup>.

It is reported that thrombocytopenia occurs in 80% of patients of malaria, infected with *P. vivax* or *P. falciparum*. Thrombocytopenia is caused by accelerated platelet destruction and underlying mechanisms remain to be elucidated<sup>8</sup>. The aim of the present study is to evaluate the white blood cell counts, platelete count with their correlation with different types of malaria and to visualize the species of plasmodia in malaria. Changes in these parameters may help in the

assessment of disease prognosis and prevention of its complication.

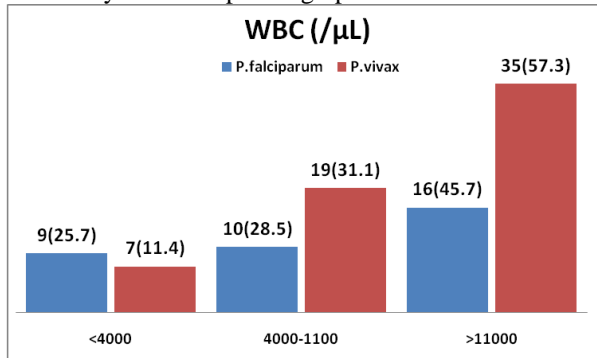
**MATERIALS AND METHODS**

The present study was carried out at Pathology department, Isra University. The samples were collected from ER, Pediatric and general medicine ward Isra hospital Hyderabad. This cross sectional study was conducted during January 2014 to June 2014. The patients with clinical features suggestive of malaria having high grade fever and chills and positive blood smear showing malarial parasite were included in the study. The age range of the patients was between 05 to 59 years. Pregnant patients or patients who have already started anti malarial treatment and patients having typhoid, dengue and meningitis were not included in the study.

The blood for hematological parameters and thick and thin peripheral film preparation was collected in EDTA tubes. To observe the various morphological forms of plasmodium peripheral blood films were stained with Leishman’s stain. The WBC and platelet counts were determined using automated hematology analyser. Data was analyzed using SPSS version 21.0. The calculation of Mean ± SD for quantitative variables and frequency and percentages for categorical variables was done. The statistical significance between categorical groups was calculated by Chi square test. The P-value < 0.05 was considered as statistically significant.

**RESULTS**

A total of 96 blood samples from malaria patients were studied. Leukocytosis was noted in 16 (45.7%) and 35 (57.3%) of P. falciparum and P. vivax patients respectively. However, leucopenia was also observed noticeably in P. falciparum graph 1.



**Graph No.1: White blood cell counts in P.falciparum & P.vivax patients**

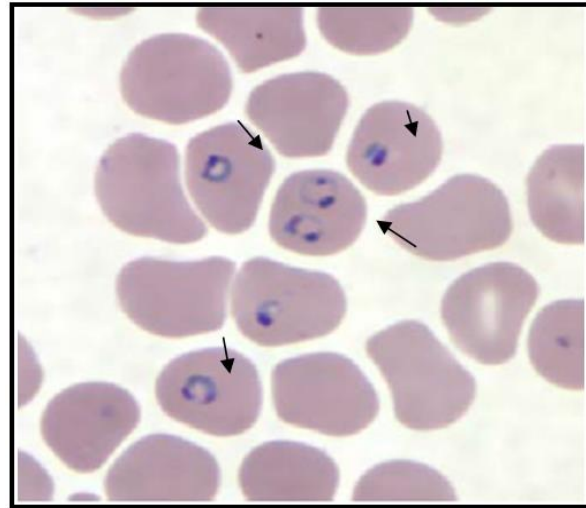
Thrombocytopenia was noted in 32 (91.4%) and 47 (77%) of P. falciparum and P. vivax patients respectively. Frequency of thrombocytopenia was more in P. falciparum patients compared to P. vivax as indicated by statistically significant p-value (p=0.0001) in table-1.

**Table No.1: Platelet counts in study population (n=96)**

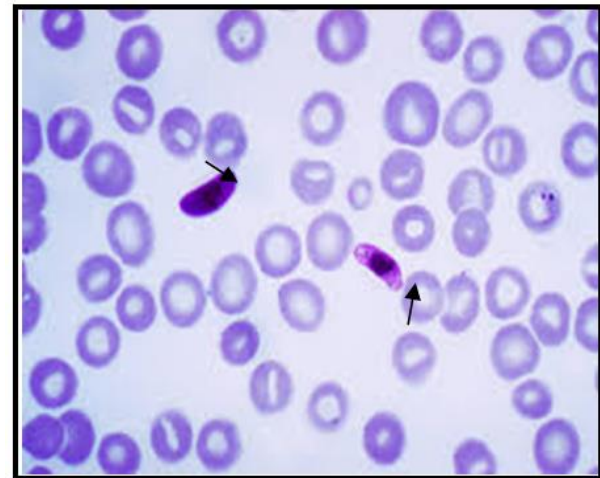
| Platelets (millions/ $\mu\text{L}$ ) | P.falciparum (n=35) | P.vivax (n=61) | p-value |
|--------------------------------------|---------------------|----------------|---------|
| <0.5                                 | 22 (62.8%)          | 29 (47.5%)     | 0.0001  |
| 0.5- 1.0                             | 8 (22.8%)           | 12 (19.6%)     |         |
| 1.0- 1.5                             | 2 (5.7%)            | 6 (9.8%)       |         |
| 1.5-3.5                              | 2 (5.7%)            | 9 (14.7%)      |         |
| >3.5                                 | 1(2.8%)             | 5 (8.1%)       |         |

Chi square test applied.

Peripheral blood smear revealed ring forms and trophozoites in both P.falciparum and P.vivax. Typical headphone appearance of ring forms of P.falciparum is shown in figure-1. Banana shaped gametocytes of P. falciparum are shown in figure-2.



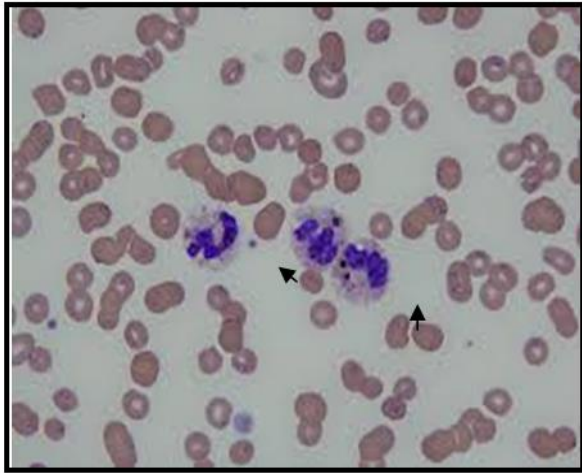
**Figure No.1: Peripheral blood smear showing headphone appearance of P. falciparum within RBC (thin blood film)**



**Figure No.2: Peripheral blood smear showing banana shaped gametocyte (thin blood film)**

On peripheral film schizonts are also seen. Ring and trophozoites forms of P.vivax were seen and leukocyte pigments were an important finding observed in present study as shown in figure-3. The schistocytes, red blood

cell inclusions, anisocytosis and poikilocytosis with fragmented RBC were other findings observed in the present study.



**Figure No.3: Peripheral blood smear showing malaria pigment in polymorphs**

## DISCUSSION

The present study is an original research work on hematological changes in malaria conducted at Department of Pathology and Medicine, Isra University Hospital Hyderabad. Our tertiary care hospital caters thousands of patients from different areas of Sindh. Many studies have reported a wide variation of malaria frequency, clinical severity, blood changes and clinical outcome due to multiple factors, like mosquito breeding, sanitary and public health issues, natural immunity and genetic predisposition to develop complications. The malaria is taking lives of many people and these deaths are preventable if detected earlier with an effective treatment strategy.

In the present study leukocytosis was noted in 16 (45%) and 7 (11.4%) of *P. falciparum* and *vivax* patients respectively. Leucopenia was also observed noticeably in *P. falciparum*. Similar findings have been reported by previous studies<sup>9-13</sup>.

Leukopenia is reported to be due to splenic sequestration of WBC, shifting to peripheral microcirculation and depletion in combating concurrent infections<sup>9,11,13,14</sup>.

It has been reported that the leukocytosis may suggest concurrent viral infections particularly in lymphocytic leukocytosis<sup>15</sup>. Many recent studies also showed leukocytosis in the malaria patients. Adedapo et al (2007) has reported 9.5% frequency of leukocytosis in his study<sup>16</sup>. Leukocytosis has been implicated as a poor risk factor in malaria with poor outcome. A previous study had reported leukocytosis to be a poor prognostic factor in juvenile *P. falciparum* patients<sup>17</sup>.

Thrombocytopenia was noted in 32 (91.4%) and 47 (77%) of *P. falciparum* and *P. vivax* patients respectively. Frequency of thrombocytopenia was more

in *P. falciparum* patients compared to *P. vivax*. The findings are in agreement with previous studies<sup>11,12,18,19</sup>. Memon et al<sup>20</sup> has reported a frequency of 70% of thrombocytopenia in malaria. Malik et al<sup>10</sup> reported 70% of the study populations have had thrombocytopenia with a platelet count  $\leq 150,000$  per  $\mu\text{L}$ . Thrombocytopenia noted in present study is highly supporting the above mentioned studies.

In the study by NADEEM, et al<sup>21</sup> thrombocytopenia was observed in 83% of *P. falciparum* patients and in 70% of *P. vivax* patients, these findings are also consistent with present study. Many previous studies had reported similar results of thrombocytopenia in malaria<sup>9,11,13</sup>. A study from United Kingdom reported thrombocytopenia as of prognostic value in malaria patients<sup>22</sup>.

Platelet activation is one of the recent mechanisms suggested to account for the thrombocytopenia in human malaria. It is also reported that the half life of malaria is shortened in peripheral circulation due to splenic sequestration<sup>23</sup>. Loss of sialic acid, ADP dependent activation and oxidative stress are a few proposed underlying mechanisms of thrombocytopenia in malaria<sup>9-11,24,25</sup>.

Peripheral blood smear showed ring forms and trophozoites in both *P. falciparum* and *P. vivax*. Typical headphone resembling ring forms of *P. falciparum* and crescent shaped (*Banana shaped*) gametocytes of *P. falciparum* are seen. Ring and trophozoites forms of *P. vivax*, schistocytes and red blood cell inclusions along with anisocytosis and poikilocytosis were noted with fragmented RBC.

Malaria pigment may serve as a peripheral indicator of parasite density and disease severity, since the pigment may be observed in monocytes and polymorphonuclear leukocytes (PMNs) under light microscopy. The presence of pigment has been strongly associated with severe disease rather than with uncomplicated cases of malaria. Pigmented neutrophils have been associated with cerebral malaria and deaths in children. Leukocyte pigments were an important finding observed in present study.

The findings of the present study suggest that creating interest of physicians will make patient management effective and mortality may then be reduced. Mortality if it occurs due to malaria in present era is shame for medical people.

## CONCLUSION

The present study revealed leukocytosis, leukopenia, leukocytic pigment and thrombocytopenia as the most common haematological findings among malaria patients.

### Author's Contribution:

Concept & Design of Study: Umair Ali Soomro  
Drafting: Shomail Saeed Siddiqui

Data Analysis: Shomail Saeed Siddiqui  
 Revisiting Critically: Umair Ali Soomro,  
 Shomail Saeed Siddiqui  
 Final Approval of version: Umair Ali Soomro,

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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