Research Article

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Thrombocytopenia as a Promising Diagnostic Indicator in Plasmodium falciparum Malaria: A Case-Control Study in Shendi, Sudan

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ABSTRACT

Background: *Malaria, caused by Plasmodium falciparum, is a life-threatening disease often associated with hematological abnormalities. Thrombocytopenia is a common complication, but its consistency as a diagnostic marker in specific populations like Sudan requires further investigation. This study aimed to compare platelet counts between P. falciparum-infected and uninfected individuals in Shendi, Sudan.*

Methods: *A hospital-based case-control study was conducted in March 2015, involving 100 participants (50 confirmed P. falciparum patients and 50 healthy controls). Malaria diagnosis was confirmed by microscopic examination of Giemsa-stained blood films. Platelet counts were determined using an automated hematology analyzer (Sysmex). Data were analyzed using SPSS, with a p-value < 0.05 considered statistically significant.*

Results: *The mean platelet count was significantly lower in the P. falciparum-infected group ($142.7 \times 10^3/\mu L$) compared to the control group ($281.8 \times 10^3/\mu L$) ($p < 0.001$). Within the patient group, males had a lower mean platelet count ($128.7 \times 10^3/\mu L$) than females ($150.7 \times 10^3/\mu L$).*

Conclusion: *The study demonstrates a strong association between P. falciparum malaria and thrombocytopenia in the study population. Platelet count evaluation, which is rapid and cost-effective, could serve as a valuable supportive diagnostic tool for malaria in resource-limited settings like Sudan, potentially aiding in early suspicion and diagnosis.*

Keywords

Plasmodium falciparum, Malaria, Thrombocytopenia, Platelet Count, Diagnostic Marker, Sudan.

Introduction

Malaria remains a significant global health burden, with the World Health Organization (WHO) estimating 247 million cases and 619,000 deaths in 2021 alone, the majority of which were caused by *Plasmodium falciparum* in the WHO African Region [1]. The clinical presentation of malaria is diverse, ranging from uncomplicated fever to severe life-threatening complications such as cerebral malaria, severe anemia, and acute respiratory distress syndrome [2]. Hematological alterations are a hallmark of *P. falciparum* infection. Among these, thrombocytopenia,

a reduction in platelet count below the normal range, is one of the most frequently observed abnormalities, with reported prevalence rates exceeding 50% in many studies [3,4]. The pathogenesis of malarial thrombocytopenia is multifactorial, involving mechanisms such as immune-mediated destruction, sequestration of platelets in the spleen, enhanced consumption in disseminated intravascular coagulation (DIC), and dysregulated platelet production in the bone marrow [5,6]. While microscopic examination of blood films remains the gold standard for malaria diagnosis, it is time-consuming and requires expertise, which may be scarce in peripheral health facilities. Rapid diagnostic tests (RDTs) have improved access to diagnosis, but concerns about sensitivity, specificity, and persistent antigenicity remain [7]. Therefore, identifying simple, automated, and readily available laboratory parameters that can raise suspicion of malaria is of great clinical value.

The automated complete blood count (CBC) is a fundamental test performed in most hospitals. If a low platelet count proves to be a consistent feature of malaria, it could alert clinicians to the possibility of the disease, prompting specific diagnostic testing. This study was conducted to evaluate the association between *P. falciparum* infection and platelet count in Shendi, Sudan, and to assess the potential utility of thrombocytopenia as a supportive diagnostic indicator

Materials and Methods

Study Design and Population

A descriptive cross-sectional, case-control study was conducted in Shendi, River Nile State, Sudan, in March 2015. A total of 100 participants were enrolled, comprising 50 individuals with microscopy-confirmed *P. falciparum* malaria (cases) and 50 aparasitemic, healthy individuals (controls).

Ethical Consideration

Ethical approval was obtained from the appropriate institutional review board. Written informed consent was secured from all participants or their guardians prior to enrollment.

Sample Collection and Malaria Diagnosis

Approximately 2 mL of venous blood was collected from each participant into EDTA-containing vacuum tubes. Thin and thick blood films were prepared, Giemsa-stained, and examined under oil immersion microscopy by experienced microscopists for the identification and quantification of
P. falciparum.

Platelet Count Determination

Platelet counts were performed using an automated hematology analyzer (Sysmex, Japan) according to the manufacturer's instructions. This method ensures accurate and reproducible results.

Statistical Analysis

Data were entered and analyzed using SPSS software (version 22.0, IBM Corp., USA) and Microsoft Excel. Descriptive statistics were used to summarize demographic and laboratory data. An independent samples t-test was used to compare the mean platelet counts between the case and control groups. A p-value of less than 0.05 was considered statistically significant.

Results

Demographic Characteristics

The study comprised 100 participants with a mean age of 35 years. The *P. falciparum*-infected group consisted of 18 males (36%) and 32 females (64%).

Comparison of Platelet Counts

The analysis revealed a highly significant difference in platelet counts between the two groups. The mean platelet count in the *P. falciparum*-infected group was 142.7 × 10^3/µL (Standard Deviation, SD, can be added if available), which was substantially lower than the mean count of 281.8 × 10^3/µL in the control group ($p < 0.001$) (Table 1).

Table 1: Comparison of mean platelet counts between microscopy-confirmed *Plasmodium falciparum* malaria patients and healthy controls in Shendi, Sudan (March 2015, n = 100).

Groups	Number (n)	Mean Platelet Count (× 10^3/µL)	p-value
Pf-Infected	50	142.7	**< 0.001**
Control	50	281.8	

Mean platelet counts by sex among microscopy-confirmed *Plasmodium falciparum* malaria patients in Shendi, Sudan (March 2015, n = 50)

Within the *P. falciparum*-infected cohort, the mean platelet count was lower in males (128.7 × 10^3/µL) compared to females (150.7 × 10^3/µL) (Table 2).

Table 2: Mean Platelet Count by Sex among *P. falciparum*-Infected Individuals.

Sex	Number (n)	Percentage (%)	Mean Platelet Count (× 10^3/µL)
Male	18	36%	128.7
Female	32	64%	150.7

Discussion

This study provides clear evidence of a significant association between *P. falciparum* malaria and thrombocytopenia in a Sudanese population. The markedly reduced platelet count in infected individuals (142.7 × 10^3/µL) compared to healthy controls (281.8 × 10^3/µL) aligns with a substantial body of research from various malaria-endemic regions [8,9].

The pathogenesis of thrombocytopenia in malaria is complex. Proposed mechanisms include: (1) Immune-mediated destruction: Antibodies directed against parasitic antigens may cross-react with platelet surface glycoproteins, leading to their opsonization and clearance by the spleen [5]. (2) Splenic sequestration: The hypersplenism associated with acute malaria leads to increased trapping and removal of platelets from circulation [6]. (3)

Platelet activation and consumption: *P. falciparum*-infected red blood cells can activate platelets, leading to their aggregation and consumption in microthrombi, a process that may be linked to severe disease [10]. (4) Bone marrow suppression: Although debated, some studies suggest a direct suppressive effect of the parasite on megakaryopoiesis [11].

Our findings are consistent with recent studies. A 2011 meta-analysis by Lacerda et al. confirmed that thrombocytopenia is a strong predictor of malaria, with high sensitivity and specificity [12]. Similarly, a study in Ethiopia by Alemu et al. found that platelet count could differentiate malaria from other febrile illnesses with good accuracy [9]

Limitations

This study was conducted in a single center with a relatively small sample size. The cross-sectional design can establish association but not causality. Information on disease severity, parasite density, and other confounding factors like co-infections was not available for analysis.

Conclusion

In conclusion, this study confirms that thrombocytopenia is a prominent and consistent hematological feature of *P. falciparum* malaria in Shendi, Sudan. The routine CBC, which includes a platelet count, can be a valuable asset in the diagnostic process. We recommend that clinicians in endemic areas consider malaria a leading differential diagnosis in any febrile patient presenting with thrombocytopenia. Future prospective studies with larger sample sizes should focus on establishing a definitive platelet count cut-off value, correlating it with parasite density and disease severity, and evaluating its cost-effectiveness as part of an integrated diagnostic algorithm.

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