Original Article

Clinico-Hematological Profile of Malaria Diagnosed by Peripheral Blood Smear in a Tertiary Care Hospital

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Abstract

Background: Despite its low incidence in developed nations, malaria continues to be a major cause of acute febrile illness in tropical areas, and is often associated with hematological abnormalities, which can increase the severity of the illness. Laboratory diagnosis is still based primarily on the peripheral blood smear examination. The objective is to compare the clinical and hematological profile of malaria diagnosed from peripheral blood smear and to determine whether there are any correlations between the hematological abnormalities and Plasmodium species. **Material and Methods:** A total of 150 patients with blood smear confirmed malaria were subjected to this prospective observational study that was performed in a tertiary care hospital. The clinical characteristics, malaria species and hematological indices such as red cell indices, hemoglobin, total leukocyte count, hematocrit and platelet count were studied. Data were analysed statistically using SPSS version 25.0. **Results:** The majority were aged between 21 and 40 years and males constituted 62.7% of the study population. P. vivax was detected in 64.0% of the cases, P. falciparum was detected in 30.7% of cases and mixed infection was detected in 5.3% of cases. All the patients had fever, chills and rigors. The most frequent hematological abnormality was thrombocytopenia (69.3%) followed by anemia (54.7%). The frequencies of anemia, thrombocytopenia, and severe thrombocytopenia were significantly higher in patients with P. falciparum infection compared to those with P. vivax infection ($p<0.05$). Abnormalities of leukocytes occurred in a relatively small number of cases. **Conclusion:** Examination of peripheral blood smear is still a good diagnostic tool for malaria. The primary hematological abnormalities are thrombocytopenia and anemia, with P. falciparum causing greater abnormalities than P. vivax. Standard haematological tests have a useful diagnostic and prognostic role and aid in the early detection and good management of malaria.

Keywords: Malaria, Peripheral Blood Smear, Plasmodium vivax, Plasmodium falciparum, Thrombocytopenia, Anemia, Hematological Profile.

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Introduction

Malaria is still one of the most important mosquito-borne parasitic diseases in the world and is still a serious public health problem especially in tropical and sub-tropical countries. Despite the enormous progress made in the control of malaria, the disease still causes considerable morbidity and mortality, particularly in children, pregnant women and immunocompromised persons. The World Malaria Report 2024 indicates that around 263 million malaria cases were recorded worldwide and some 597,000 people died from the disease, with the African and Southeast Asian regions accounting for a large share of the disease burden. India has made significant strides towards malaria elimination, but malaria is still endemic in several states, and continues to be a significant contributor to acute febrile illnesses.[1-3]

Malaria is caused by protozoan parasites of the genus Plasmodia and the most common species involved in human infection in India include Plasmodium falciparum and Plasmodium vivax. Although previously regarded as relatively harmless, P. vivax is now known to cause severe complications, such as anemia, thrombocytopenia, acute kidney injury, hepatic dysfunction, and cerebral involvement, while P. falciparum is primarily associated with severe malaria and increased mortality. Early diagnosis and timely interventions are therefore crucial to minimize the disease-related complications and death.[4-6]

Malaria is still diagnosed in the laboratory by peripheral blood smear examination which enables the direct visualization of malaria parasites, identification of the infecting species, quantification of the parasite load and evaluation of treatment response. Thick blood smears are more sensitive for the detection of the parasites, while thin smears help in the species identification and estimation of the parasitemia. In spite of the increasing availability of rapid diagnostic tests and molecular diagnostics, peripheral blood smear examination remains important due to its high diagnostic accuracy, cost effectiveness

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and usefulness of hematological information.[2,7]

Malaria is often accompanied with severe hematological changes such as hemolysis, bone marrow suppression, immune mediated destruction and sequestration of blood cells in the spleen. The most frequent laboratory abnormalities include anemia and thrombocytopenia, and sometimes leukocytosis and leukopenia occur depending on the severity and stage of infection. Assessment of hematological parameters not only contributes to the diagnosis of malaria but also serves to gauge the severity of the disease, to predict the complications and to monitor therapeutic response.[5-7]

A number of studies have shown that thrombocytopenia is one of the most consistent haematological features of malaria and could be a useful clue in the diagnosis of acute febrile illness in an endemic area where a patient has thrombocytopenia. Similarly, changes in haemoglobin, haematocrit, total leucocyte count and differential leucocyte count have been correlated with the species of parasites and the degree of the disease. Comprehensive evaluation of the clinico-hematological profile of malaria can therefore contribute to early diagnosis, timely intervention, and improved patient outcomes.[6,7]

In view of the continued burden of malaria and the clinical importance of hematological abnormalities, the present study was undertaken to evaluate the clinical and hematological profile of malaria diagnosed by peripheral blood smear in patients attending a tertiary care hospital and to assess the association between hematological parameters and malaria infection.

Materials and Methods

Study Design: This was a prospective observational study conducted to evaluate the clinico-hematological profile of malaria diagnosed by peripheral blood smear.

Study Setting: The study was carried out in the Department of Pathology in collaboration with the Departments of General Medicine and Microbiology at a tertiary care teaching hospital.

Study Duration: The study was conducted over a period of 24 months after obtaining approval from the Institutional Ethics Committee.

Sample Size: A total of 150 patients diagnosed with malaria by peripheral blood smear examination were included in the study.

Study Population: Patients presenting with acute febrile illness and confirmed malaria on peripheral blood smear examination were enrolled consecutively during the study period.

Inclusion Criteria

- Patients of all age groups with fever suspected to be malaria.
- Peripheral blood smear positive for Plasmodium species.
- Patients providing informed written consent (or consent from parents/guardians for minors).
- Newly diagnosed malaria cases before initiation of antimalarial therapy.

Exclusion Criteria

- Patients already receiving antimalarial treatment before sample collection.
- Patients with coexisting hematological disorders such as leukemia, aplastic anemia, or hemoglobinopathies.
- Patients with confirmed dengue, leptospirosis, typhoid, septicemia, or other causes of thrombocytopenia or anemia.
- Patients with incomplete clinical or laboratory records.
- Patients unwilling to participate.

Study Procedure: After obtaining informed consent, detailed demographic information and clinical history were recorded, including age, gender, duration of fever, chills and rigors, headache, vomiting, abdominal pain, jaundice, bleeding manifestations, altered sensorium, and other presenting symptoms. Clinical examination findings such as pallor, icterus, hepatomegaly, splenomegaly, and vital signs were documented.

Venous blood samples were collected under aseptic precautions. Thick and thin peripheral blood smears were prepared and stained with Giemsa stain. Smears were examined independently by experienced pathologists/microbiologists under oil immersion (1000× magnification). Malaria parasites were identified, species were determined (P. vivax, P. falciparum, or mixed infection), and parasite density was assessed where feasible.

Complete blood count was performed using an automated hematology analyzer. The following hematological parameters were recorded:

- Hemoglobin (Hb)
- Total leukocyte count (TLC)
- Differential leukocyte count (DLC)
- Platelet count
- Hematocrit (PCV)
- Red blood cell count (RBC)
- Mean corpuscular volume (MCV)
- Mean corpuscular hemoglobin (MCH)
- Mean corpuscular hemoglobin concentration (MCHC)

Patients were also evaluated for liver and renal function tests whenever clinically indicated.

Study Variables

The following variables were analyzed:

- Age and gender distribution
- Clinical presentation
- Plasmodium species identified
- Hemoglobin level and anemia severity
- Platelet count and thrombocytopenia
- Total and differential leukocyte counts
- Hematocrit and red cell indices
- Presence of hepatomegaly and splenomegaly
- Association of hematological abnormalities with malaria species

Outcome Measures

Primary Outcome

- Clinico-hematological profile of patients with peripheral blood smear-confirmed malaria.

Secondary Outcomes

- Distribution of Plasmodium species.
- Frequency of anemia, thrombocytopenia, and leukocyte abnormalities.
- Association between malaria species and hematological parameters.

- Relationship between clinical features and hematological abnormalities.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons between Plasmodium species and hematological parameters were performed using the Chi-square test, Student's t-test, or one-way ANOVA, as appropriate. A p-value <0.05 was considered statistically significant.

Results

A total of 150 patients with peripheral blood smear-confirmed malaria were included in the study. The demographic profile, clinical presentation, malaria species, and hematological parameters were analyzed.

Table 1: Demographic Profile and Distribution of Plasmodium Species (n = 150)

Variable	Number (n)	Percentage (%)
Age Group (Years)		
<20	24	16.0
21–40	68	45.3
41–60	42	28.0
>60	16	10.7
Gender		
Male	94	62.7
Female	56	37.3
Plasmodium Species		
P. vivax	96	64.0
P. falciparum	46	30.7
Mixed infection	8	5.3

Most patients belonged to the 21–40 years age group (45.3%). Males were more frequently affected than females (62.7% vs. 37.3%). Plasmodium vivax was the predominant species identified (64.0%), followed by P. falciparum (30.7%), while mixed infections accounted for 5.3% of cases.

Table 2: Clinical Profile of Patients with Malaria (n = 150)

Clinical Feature	Number (n)	Percentage (%)
Fever with chills and rigors	150	100.0
Headache	118	78.7
Generalized weakness	112	74.7
Vomiting	68	45.3
Pallor	54	36.0
Splenomegaly	49	32.7
Hepatomegaly	32	21.3
Icterus	20	13.3
Bleeding manifestations	8	5.3
Altered sensorium	5	3.3

Fever with chills and rigors was present in all patients (100%), followed by headache (78.7%) and generalized weakness (74.7%). Pallor and splenomegaly were common clinical findings, while severe manifestations such as bleeding and altered sensorium were observed in a small proportion of patients.

Table 3: Hematological Profile of Malaria Patients (n = 150)

Hematological Parameter	Number (n)	Percentage (%)
Hemoglobin <10 g/dL (Anemia)	82	54.7
Platelet count <150,000/µL (Thrombocytopenia)	104	69.3
Severe thrombocytopenia (<50,000/µL)	24	16.0
Leukopenia (<4,000/µL)	22	14.7
Leukocytosis (>11,000/µL)	18	12.0
Hematocrit <35%	60	40.0

Thrombocytopenia was the most frequent hematological abnormality (69.3%), followed by anemia (54.7%). Severe thrombocytopenia was observed in 16.0% of patients. Leukocyte abnormalities were less common, whereas reduced hematocrit was found in 40.0% of cases.

Table 4: Association Between Plasmodium Species and Hematological Abnormalities

Hematological Parameter	P. vivax (n=96)	P. falciparum (n=46)	Mixed Infection (n=8)	p-value
Anemia	46 (47.9%)	31 (67.4%)	5 (62.5%)	0.028
Thrombocytopenia	60 (62.5%)	38 (82.6%)	6 (75.0%)	0.019
Severe thrombocytopenia	10 (10.4%)	12 (26.1%)	2 (25.0%)	0.011
Leukopenia	12 (12.5%)	8 (17.4%)	2 (25.0%)	0.418

Patients with P. falciparum infection exhibited significantly higher frequencies of anemia, thrombocytopenia, and severe thrombocytopenia compared with those infected with P. vivax ($p<0.05$). Although leukopenia was more frequent in P. falciparum and mixed infections, the difference was not statistically significant ($p=0.418$). These findings indicate that P. falciparum infection is associated with more pronounced hematological abnormalities and greater disease severity.

Discussion

Malaria continues to be a major public health problem in tropical countries, and hematological abnormalities are among the most important laboratory manifestations that aid in diagnosis and assessment of disease severity. In the present study, clinico-hematological profile of malaria cases with confirmed malaria from peripheral blood smears and the changes of hematological parameters were evaluated and it was observed that thrombocytopenia, anemia was the most common hematological abnormalities observed and were more severe in cases of P. falciparum infection.

Here, most of the patients in the present study were in the age group of 21- 40 years and the male predominance was evident (62.7%). Sixty-four percent of the isolates were P. vivax, followed by P. falciparum (30.7%). The study results are similar to the study conducted by Lathia and Joshi which conclude that the most affected age group in the malaria endemic area are young adults and P. vivax is the most common species in many areas of India. They also highlighted the value of peripheral blood smear examination in the identification of species and estimation of parasitemia. All patients had fever and rigors and headache and generalized weakness were common presenting features, with splenomegaly, were present in all. Also similar clinical findings were noted by Maina et al., who showed that the most common clinical symptom of malaria is fever with constitutional signs, and that the March of pallor and splenomegaly is strongly associated with high level of parasitemia and haematological involvement.

In the present study, the most common hematological abnormality was thrombocytopenia (69.3%) followed by anemia (54.7%). These observations are consistent with an earlier and constant laboratory change in malaria reported by Erhart et al. that were due to peripheral destruction of platelets, sequestration in the spleen, immune mediated mechanisms and consumption during infection.[10]

Patients infected with P. falciparum had a significantly higher frequencies of anemia, thrombocytopenia, and severe thrombocytopenia than those with P. vivax infection. Patel et al. showed that moderate and high grade thrombocytopenia was linked to greater parasite counts and more common in P. falciparum malaria, and this was also seen in this study. They recommended that platelet count might be useful to measure the severity of the disease in endemic zones.[11]

The anemia seen in this study may be due to hemolysis of parasitized erythrocytes, destruction of unparasitized erythrocytes, suppression of erythropoiesis and splenic sequestration. Malaria anemia was also reported as a frequent hematologic complication of malaria by Bashawri et al. [12] who stated that this might be associated with longer duration of illness and severe P. falciparum malaria.

In the present study, however, the incidence of leukopenia was low (14.7%), and leukocytosis was not seen in any patients. The same thing was stated by Faseela et al, who suggested that although leukocytes are normally in normal ranges, the presence of fever, cytoineutrophenia should be viewed as a strong indicator of the presence of malaria in the endemic region.

Furthermore, the present study showed that P. falciparum infection had a higher degree of severity of hematological abnormalities than P. vivax. The results are in line with the study done by Kochar et al. who noted that while P. vivax could cause serious malaria, P. falciparum is linked to higher hematological derangements, multiorgan involvement, and higher morbidity rates.[14]

Hematological parameter is very much affected by parasite density and species. Kotepui et al. found progressive decrease in hemoglobin, platelet count and hematocrit with an increase in parasitemia and that severe thrombocytopenia was an important predictor of complicated malaria. These observations are confirmed by the results of the present study and highlight the need for regular hematological examination in malnourished people suspected of having malaria.

Based on the analysis of this present study, it is concluded that the peripheral blood smear is still the best test for the diagnosis of malaria, Hematological abnormalities (Nevertheless anemia, thrombocytopenia are the broadly seen laboratory findings.) are common. Identifying these abnormalities early can help make a quick diagnosis and treatment and prevent serious complications.

Conclusion

The present study finds that the most common hematological diseases in patients with confirmed malaria in the peripheral blood smear are thrombocytopenia and anemia. The predominant infecting species was Plasmodium vivax and P. falciparum infection was found to be strongly significantly associated with severe hematological changes, especially anemia and thrombocytopenia. The peripheral blood smear is still considered the "gold standard" method of species identification and diagnosis and laboratory examinations of other routine hematological parameters are useful in determining the degree and prognosis of disease. Proper recognition and evaluation of haematological abnormalities in early diagnosis can help in timely treatment, minimising complications and enhancing the outcomes.

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Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. World malaria report 2024. Geneva: World Health Organization; 2024.
2. World Health Organization. Guidelines for malaria. Geneva: World Health Organization; Updated 2023.

3. National Center for Vector Borne Diseases Control. National Framework for Malaria Elimination in India 2016–2030. New Delhi: Ministry of Health and Family Welfare, Government of India; 2016.
4. White NJ, Pukrittayakamee S, Hien TT, Faiz MA, Mokuolu OA, Dondorp AM. Malaria. Lancet. 2014;383(9918):723-735. doi:10.1016/S0140-6736(13)60024-0.
5. Cowman AF, Healer J, Marapana D, Marsh K. Malaria: Biology and disease. Cell. 2016;167(3):610-624. doi:10.1016/j.cell.2016.07.055.
6. Ashley EA, Pyae Phyo A, Woodrow CJ. Malaria. Lancet. 2018;391(10130):1608-1621. doi:10.1016/S0140-6736(18)30324-6.
7. Tangpukdee N, Duangdee C, Wilairatana P, Krudsood S. Malaria diagnosis: A brief review. Korean J Parasitol. 2009;47(2):93-102. doi:10.3347/kjp.2009.47.2.93.
8. Lathia TB, Joshi R. Can hematological parameters discriminate malaria from nonmalarious acute febrile illness in the tropics? Indian J Med Sci. 2004;58(6):239-244.
9. Maina RN, Walsh D, Gaddy C, Hongo G, Waitumbi J, Otieno L, et al. Impact of Plasmodium falciparum infection on hematological parameters in children living in Western Kenya. Malar J. 2010;9(Suppl 3):S4. doi:10.1186/1475-2875-9-S3-S4.
10. Erhart LM, Yingyuen K, Chuanak N, Buathong N, Laoboonchai A, Miller RS, et al. Hematologic and clinical indices of malaria in a semi-immune population of Western Thailand. Am J Trop Med Hyg. 2004;70(1):8-14.
11. Patel U, Gandhi G, Friedman S, Niranjan S. Thrombocytopenia in malaria: Correlation with clinical and laboratory findings. Platelets. 2004;15(3):143-145. doi:10.1080/09537100410001682583.
12. Bashawri LA, Mandil AA, Bahnassy AA, Ahmed MA. Malaria: Hematological aspects. Ann Saudi Med. 2002;22(5-6):372-376. doi:10.5144/0256-4947.2002.372.
13. Faseela TS, Ronald AR, Anita KB, Chaithra SM, Yashwanth R. Diagnostic value of platelet count in malaria. J Clin Diagn Res. 2011;5(3):464-466.
14. Kochar DK, Das A, Kochar SK, Saxena V, Sirohi P, Garg S, et al. Severe Plasmodium vivax malaria: A report on serial cases from Bikaner in northwestern India. Am J Trop Med Hyg. 2009;80(2):194-198.
15. Kotepui M, PhunPhuech B, Phiwklam N, Chupeerach C, Duangmano S. Effects of malaria parasite density on blood cell parameters. PLoS One. 2015;10(3):e0121057. doi:10.1371/journal.pone.0121057.