

Original Research Article

Haematological Parameters in Malaria: A Clinico Pathological Study from a Tertiary Care Centre

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Abstract

Introduction: Malaria causes death of about 1.1 to 2.7 million people annually of which majority are children under five years. Hematological changes are some of the most common complications in malaria and they play a major role in malarial pathogenesis. These changes involve the major cell types such as RBC, leucocytes and thrombocytes. This study aimed to access the changes in haematological parameters in smear positive malaria cases, to see the changes in biochemical parameters in smear positive malaria cases and to compare these changes in *P. vivax* and *P. falciparum* infection. *Material and Methods:* This observational study was conducted in a tertiary care center during the period of May 2017 to May 2018. Total two hundred smear positive malaria cases were examined for various hematological parameters and biochemical parameters. *Results:* Results of the present study showed that 110 cases were *P. Vivax* positive while 90 patients were *P. Falciparum* positive among 200 smear positive cases. Majority of the patients (70%) have shown either mild (40%) or moderate degree (30%) of anemia. Among 9% of malaria patients Hb Concentration was <7 gm%. Most of the patients (68%), showed haematocrit level in the range of 20-35%. In anemic patients, commonly found RBC morphology were normocytic, normochromic (64.55%) followed by microcytic hypochromic (29.11%) nearly equal in both *P. falciparum* and *P. vivax* malaria. Platelet counts were less than 1.5 lakhs/mm³ both types of malaria patients (71%). Further, severe thrombocytopenia (<50,000) was recorded in 19 malaria patients. *Conclusion:* Findings of the current study suggest that careful observation of haematological findings are warranted in the malaria patient as anaemia and thrombocytopenia of varying degree of severity have been found in malaria patients. Further, results of the present study showed that *P. Falciparum* and *P. Vivax* are associated with serious complications like severe anaemia and malarial hepatitis without any significant difference between both species. Hence, both *P. Falciparum* and *P. Vivax* infections on suspicion of complication should be further evaluated. However, more studies on larger populations are warranted to assess the haematological parameters in malaria.

Keywords: Malaria; Thrombocytopenia; Leucocytosis; Anaemia.

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Introduction

“Malaria” word originates from Medieval Italian (mala aria) means bad air alongside marshy regions. Global efforts to control malaria in recent decades have made little progress, and it remains the most widespread arthropod-borne disease [1,2]. Its clinical features overlap with many other diseases it is often difficult to diagnose quickly. Malaria claims 1.1 to 2.7 million lives annually and over 40% of the world’s population is at risk of contracting malaria, since they live in malaria endemic areas [1]. Malaria is a major health problem in India, being one of the biggest troubles in terms of morbidity and mortality among all infectious diseases [2].

Blood one of the most easily accessible tissues of the body which is used for rapid diagnosis of hematological changes found in malaria. Besides, hematological changes are among the most common complications in malaria which play a major role in malarial pathogenesis. These changes involve the major cell types such as RBC’s, leucocytes and thrombocytes. So the hematological alteration that have been account to come along with malaria include anemia, thrombocytopenia and leucocytosis, leucopenia, mild to moderate atypical lymphocytosis, monocytosis, eosinophilia and neutrophilia [3-8]. Platelet abnormalities are both qualitative as well as quantitative. Thrombocytopenia is common and early sign of malarial infection and it is observed in vivax and falciparum malaria to varying degrees [6-10]. Thrombocytopenia has been found associated with cases of malaria related to renal and hepatic destruction [11]. WHO defined that Hepatic involvement in *P. falciparum* malaria is not an uncommon presentation and presence of jaundice (bilirubin >3mg/dl) is one of the pointer of severe malaria.

In falciparum malaria jaundice may diverge from mild to severe and is related with high incidence of complications and mortality [12]. Anemia is another of the many manifestations and results from red blood cells destruction through parasite invasion [10].

Malaria is associated with two major renal syndromes, one is acute renal failure associated with falciparum malaria in Southeast Asia, India, and sub-Saharan Africa and another is a chronic and progressive glomerulopathy that mainly affects African children, classically complicating quartan malaria [13]. Renal impairment is mainly caused by *P. falciparum*; however, vivax malaria also causes renal impairment [14].

Hence the present study was undertaken to evaluate the various haematological parameters as

well as biochemical parameters affected in malaria and to observe the variations if any, in *P. falciparum*, *P. vivax* and mixed infections. This study aimed to access the changes in haematological parameters in smear positive malaria cases, to see the changes in biochemical parameters in smear positive malaria cases and to compare these changes in *P. vivax* and *P. falciparum* infection.

Material and Methods

Source of data

This observational study was conducted in in a tertiary care center during the period of May 2017 to May 2018. According to performa, detailed history regarding age, sex, nature, and duration of illness are taken. *Inclusion criteria:* A total of 200 patients showing smear positivity for one or more species of malaria parasite. *Exclusion criteria:* Patients with a concomitant proven hematological disorder due to secondary causes, such as chronic liver disease, drug use, or associated dengue fever, were excluded from the study

In all these cases before starting anti-malarial drugs the blood samples of these patients were taken, for following laboratory investigations

Blood collection

On Cell Counter Complete Blood Count was carried out and the readings of Hematocrit (HCT), Hemoglobin (HB%), Total leukocyte count (TLC), Differential leukocyte, Platelet count were measured using Mythic 18 Automated Hematology.

Biochemical Investigations

Peripheral blood smear examination

Peripheral blood smears were prepared using fresh finger prick blood. One drop of blood placed on one side of the slide 1 cm away from the end and blood was spread using a spreader slide at an angle of 30 degrees over the length of the slide then slides were left to air dry. Slides were fixed and stained with Leishman stain. Peripheral blood smear examination was done systematically under low, high and oil immersion of microscope for

- RBC morphology
- Total leukocyte count and differential count
- Platelet adequacy
- Type of malaria parasite.

Results

Results of the present study showed that 110 cases of P. Vivax positive while 90 patients were P. Falciperum positive among 200 smear positive cases (Table 1).

Table 2 shows that total 114 male patients (57%) were suffering from malaria among them 62 malaria patients (31%) were P. Vivax positive while 52 malaria patients (26%) were P. Falciperum positive. On the other hand, P. Vivax was positive in 48 (24%) female malaria patients whereas, P. Falciperum was positive in 38 (19%) female malaria patients. Total 86 (43%) females were suffering from malaria out of total 200 patients.

All patients of malaria showed fever except one malaria patients. Chills and rigors were recorded in 64% patients of malaria. Further, vomiting and nausea were observed in 50 patients (25%) out of 200 malaria patients. Myalgia was present in (28) 14% of malaria patients.

Most common clinical sign present in the current study was pallor which was present in 55% of

malaria patients. Further, splenomegaly (32%), hepatomegaly (20%) and icterus were the clinical sign present in malaria patients. Pedal oedema and CNS involvement were recorded respectively in 5% and 4% respectively.

Table 4 shows the distribution of TLC in both P. vivax and P. falciparum malaria. Majority of the patients had normal TLC (72%). Reduced TLC in 18% and increased TLC in 10% of malaria patients were observed with nearly equal distribution in P. vivax and P. falciparum malaria. There was an insignificant difference between TLC of P. Falciperum and P. Vivax malaria patients.

Majority of the patients (70%) have shown either mild (40%) or moderate degree (30%) of anemia. Among 9% of malaria patients Hb concentration was <7 gm%. Most of the patients (68%), showed haematocrit level in the range of 20-35%.

In anemic patients, most commonly RBC's were normocytic normochromic (64.55%) followed by microcytic hypochromic (29.11%) was seen nearly equal in both P. falciparum and P. vivax malaria.

Table 1: Distribution of malaria patients according different species

Types of parasites	No. of patients	Percentage (%)
P. Vivax	110	55%
P. Falciperum	90	45%
Mixed	-	-
Total	200	100%

Table 2: Distribution according to demography

Demographic characters	P. Vivax	P. Falciperum	Total
Male	62	52	114
Female	48	38	86
Total	110	90	200

Table 3: Clinical signs if malaria patients.

Sign	P. Vivax	P. Falciperum	Percentage (%)
Pallor	56	58	55%
Icterus	8	14	11%
Pedal Oedema	4	6	5%
Splenomegaly	26	38	32%
Hepatomegaly	18	22	20%
Hepatosplenomegaly	16	18	17%
CNS involvement	2	6	4%

Table 4: Hematological parameters

Hematological parameters	P. Vivax	P. Falciperum
TLC ($\times 10^3/\mu\text{L}$)	6.44 \pm 5.62	6.52 \pm 5.73
Neutrophil ($\times 10^3/\mu\text{L}$)	66.7 \pm 16.4	68.4 \pm 15.36
Lymphocytes ($\times 10^3/\mu\text{L}$)	26.2 \pm 7.14	25.6 \pm 6.69
Monocytes ($\times 10^3/\mu\text{L}$)	6.45 \pm 2.86	6.88 \pm 3.12
Eosinophil ($\times 10^3/\mu\text{L}$)	3.16 \pm 0.96	2.89 \pm 0.86
Basophil ($\times 10^3/\mu\text{L}$)	0.88 \pm 0.22	0.95 \pm 0.35
RBC ($\times 10^6/\mu\text{L}$)	4.64 \pm 1.26	4.49 \pm 1.39
Haemoglobin (g/dl)	11.2 \pm 3.6	11.38 \pm 2.6
MCV (fl)	80 \pm 9.76	81.4 \pm 8.85
MCH (pg/cell)	25.8 \pm 6.16	26.3 \pm 6.42
MCHC (g/dl)	32.1 \pm 8.18	32.8 \pm 9.22
RDW (%)	94 \pm 10.4	90.6 \pm 9.27

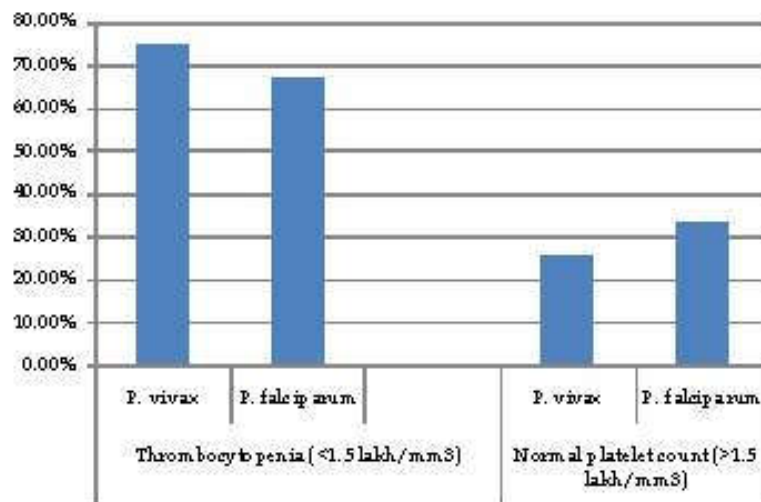


Fig. 1: Platelet count.

Fig. 1 shows that platelet counts were found less than 1.5 lakhs/mm³ both types of malaria patients (71%). Further, severe thrombocytopenia (<50,000) was recorded in 19 malaria patients.

Discussion

Malaria is one of the commonest diseases caused due to bite of female anopheles mosquito. Parasites of malaria invading and multiplying in the blood cells of patient leads to various clinical illness and pathological changes in body organs [6]. Numerous hematological alterations have been found associated with malaria.

Results of the present study showed that *P. Vivax* was more common species compare to *P. Falciperum* among study population. These findings are very similar to the findings of the previous studies of Erhart LM et al. [3], Jadhav UM et al. [6]. In contrast to the present study Bashawri LAM et al. [17] found higher prevalence of *P. Falciperum* compare to *P. Vivax*.

In India, vivax is the most common species encountered followed by falciparum. However, in recent years there has been an upswing in the falciparum cases. Malaria parasites can affect any group of human being. Eighty percent (80%) of the malaria patients of the present study belonged to adult groups of more than 20 year while rest 20% malaria patients belonged to below 20 years of age group. The mean age of the malaria patients was 32.6 Years. These findings are in agreement with the findings of previous studies of Farogh A et al. [18], Piplani S et al. [19] and Muddaiah M et al. [20]. In which they recorded higher prevalence of

malaria in adult especially mean age groups between 25 and 40. Higher prevalence of malaria in adult age groups may be due to their greater outdoor activity as increased mobility leads to increased exposure to infection.

Present study consisted 57% male patients in comparison of 43% female patients. These results are consistent with the findings of the previous studies of Jadhav UM et al. [3], Erhart LM et al. [16] and Bashawri LAM et al. [17]. Jadhav UM et al. [3], Erhart LM et al. [16] and Bashawri LAM et al. [17] recorded 41.7%, 31% and 24.1% of female patients were suffering from malaria respectively.

In present study, Fever was the commonest presenting symptom in 99% of the patients. Chills and rigor was present in 64% of the patients. Nausea and vomiting was seen in 25% of the patients. Headache was seen in 22% of the patients while Altered sensorium was seen in 4% of patients.

Results of the current study showed that pallor was the most common sign present in 55% of malaria patients followed by splenomegaly, hepatomegaly and Icterus in 32%, 20% and 11% of malaria patients correspondingly.

Anaemia is frequently observed in malaria patients, especially in developing countries. Findings of the current study suggested that anaemia (<11.5 gm%) has been observed in 79% of the malaria patients.

These findings are similar to the findings of the earlier studies of Sharma Set al. [8] and Biswas R et al. [21] as they recorded incidence of anaemia in 86.7% and 94.4% of the malaria patients respectively. Alike, Bashawri LAM et al. 3 conducted a study in

Saudi Arabia. Anaemia was recorded up to 59.2% malaria patients in their study.

Results of the current study revealed that 9% of the malaria patients were suffering from severe anaemia (<7gm%). These findings are consistent with the findings of the earlier study of Bashawri LAM et al. [3] as they recorded incidence of severe anaemia in 5.5% of malaria patients.

In contrast to the present study, Richard MW et al. [22] recorded anaemia was found in 15% of malaria patient. This wide variation in anaemia may be due to geographical location and malaria infection has deep relation. Moreover, anaemia was more pronouncedly recorded in malaria patients in developing countries compare to developed countries [8,21,22].

Increase in leucocytes counts was recorded in 10% of the malaria patients. This increase in leucocytes in Vivax was observed in 7.8% of the anaemia patients while, leucocytosis in P. Falciparum was recorded in 10.4% of malaria patients. Similar findings leucocytosis in 7.2% of patients were recorded Bashawri LAM et al. [3]. Alike to the present study Sharma SK et al. [8] and Biswas R et al. [21] observed increase of TLC up to 13.3% and 12.2% in malaria patients respectively.

Apart from this Ladhani S et al. [15] recorded leucocytosis in 20% malaria patients with P. Vivax positive while, Echieverri M et al. [23] reported leucocytosis in 5% patients of malaria with P. vivax positive patients.

Alteration in leucocytes is not definite in malaria patients as various variations have been recorded in different studies [3,15,23]. However, numerous studies recorded various different leucocytes count. Nonetheless, majority of studies reported leucocytes count in normal limits in most of the patients which is similar to the current study as present study had recorded normal leucocytes count in 72% of the malaria patients.

Current study showed that 18% of the malaria patients had leucopenia. Out of 18% malaria patients with leucopenia, 9.8% were P. Vivax positive while 8.2% were P. Falciperum positive. These findings are in agreement with the findings of the earlier study of Sharma SK et al. [8] as they recorded leucopenia in 6.6% of malaria patients with P. Falciparum positive. Likely, Ladhani S et al. [15] reported similar incidence of leucopenia in 10.2% of malaria patients with P. Falciparum positive. On the other hand, Bashawri LAM et al. [3] and Echieverri M et al. [23] observed leucopenia in 13.3% and 29% of malaria patients with P. Vivax

positive.

Findings of the current and previous studies suggest that variation in leucocytes is unpredictable in malaria patients of either parasite. Hence an alteration in the WBC count is not unprecedented either for P. falciparum or P. vivax though the quantum of changes may vary. Further, present study recorded neutrophilia in 5% while neutropenia in 12% of the malaria patients. These findings are similar to the findings of the previous study of Bashawri LAM et al. 3 as they recorded showing neutrophilia in 8.3% and neutropenia in 11.6% of malaria patients. Further, present study showed lymphocytosis in 8% of the malaria patients. Likely, Biswas et al. [21] observed lymphocytosis in 8.5% of malaria patients.

Results of the present study have shown that more than 70% of malaria patients were suffering from thrombocytopenia. These findings are very similar to the findings of the earlier study of Richards MW et al. [22] as they recorded thrombocytopenia in 67% of malaria patients.

Jaundice was recorded in 11% of malaria patients in the current study. These results are similar to the study of Kochar D et al. [24] as they reported 12% incidence of jaundice in malaria patients. Majority of jaundice patients had conjugated hyperbilirubinemia (20 out of 22); while, two jaundice patients had unconjugated hyperbilirubinemia [7]. These were very similar to the earlier study of Anand AC et al. [25], as they recorded 2.4% incidence of malarial hepatitis.

Conclusion

Findings of the current study suggest that careful observation of haematological findings are warranted in the malaria patient as anaemia and thrombocytopenia of varying degree of severity have been found in malaria patients. Further, results of the present study showed that P. Falciparum and P. Vivax are associated with serious complications like severe anaemia and malarial hepatitis without any significant difference between both species. Hence, both P. Falciparum and P. Vivax infections on suspicion of complication should be further evaluated. This can be extremely helpful for timely diagnosis and appropriate treatment of malaria to limit the morbidity and prevent further complications. However, more studies on larger populations are warranted to assess the haematological parameters in malaria.

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