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Pathology

# LEVEL OF PARASITAEMIA AND ITS RELATION TO HEMATOLOGICAL PARAMETERS AND LIVER FUNCTION AMONG PATIENTS WITH FALCIPARUM MALARIA; A STUDY FROM CENTRAL INDIA.

**KEY WORDS:** Falciparum Malaria,LFT, Haematological parameters

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ABSTRACT

**Introduction:** In India, *Plasmodium falciparum* malaria remains a very common infection.Liver involvement in severe Plasmodium falciparum infection is mainly responsible for death and disability. The clinical presentation of jaundice often reflects a certain degree of liverdamage.

**Aim:** To study the changes in hematological and hepatic function based on laboratory indices in patients with malaria infected with *P. falciparum*.

**Material and Methods:** This retrospective study done in department of pathology in a tertiary care hospital in central India. It included data collection from 46 patients diagnosed with *falciparum* malaria. The diagnosis of malaria was confirmed by thick and thin smear examination. Hematological parameters and serum levels of aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), and bilirubin (total and direct) as test indicators of liver function were studied with respect to the level of parasitaemia.

**Results:** Patients with moderate and high parasitaemia (3+ and 4+)had significantly lower hemoglobin, hematocrit, white blood cell count, lymphocytes, and platelets when compared with mild to low(3+ and 2+) parasitaemia. However, neutrophils levels, serum AST, ALT, ALP, and bilirubin (total and direct) were deranged in all patients irrespective of level of parasitaemia.

**Conclusion:** Monitoring blood parameters and hepatic function enable the clinician to establish reliable and prompt diagnosis to ensure adequate therapeutic interventions and follow up.

## Introduction

Malaria is an infectious vector-borne disease having very significant morbidity and mortality rates across the globe.[1] It is caused by a Plasmodium species namely the Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, Plasmodium malariae, and rarely Plasmodium knowlesi in human.[2] Majority of the death due to malaria is caused by P. falciparum because P. falciparum is the most common cause of malarial infection.[3]

As per the World Health Organization (WHO), malaria due to P. falciparum commonly presents with jaundice (bilirubin ≥3 mg/ dl) and involves the liver.[4]

Several studies suggest that hematologic and biochemical changes blood and there are common complications associated with this disease. Hematological changes associated with malaria ranges from anemia, thrombo-cytopenia, to life threatening condition known as disseminated intravascular coagulation (DIC) [5– 7]. Changes in haematological parameters of *P. falciparum* may vary with severity of malaria and extent of parasitaemina endemicity, presence of haemoglobinopathies, nutritional status, demograp hic factors, and level of malaria immunity [ 8, 9].

Liver involvement in malaria is common in patients of severe malaria. Hepatocytes are affected by the malarial sporozoites lead to organ congestion, sinusoidal blockage, and cellular inflammation. These changes in hepatocytes may cause leakage of parenchymal enzymes and membranous enzymes (transaminases and alkaline phosphatase) into circulation leading to elevation in liver enzymes AST, ALT, and ALP. Such changes may correlate with the hepatic stage of the parasite's life cycle in human host [10,11]. Clinically they may manifest as jaundice, hepatomegaly[12]. Hyperbilirubinemiais a common feature of *falciparum* malaria and it may bedue to hemolysisof both parasitized and nonparasitized erythrocytes and partly due to liver damage [13].Therefore, mainly unconjugated bilirubin is increased.

## Material and Methods

This retrospective study done in department of pathology MGM Medical and associated Hospital Indore during January 2014 to December 2014. Data was collected from the records and entered in Microsoft excel. A total of 46 patients diagnosed with *falciparum* malaria were included. The diagnosis of malaria was done by thick and thin film. Falciparum malaria was confirmed by gametocytes and other morphological features of parasite. Fields' staining of thin film is used commonly and is fairly sensitive for diagnosing malaria parasite. Hematological parameters and serum levels of aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), and bilirubin (total and direct) as test indicators of liver function were studied with respect to the level of parasitaemia.

**Malarial Parasite Density Determination:** *P. falciparum* parasitaemia was determined in various blood smears stained by field stain. Parasitaemia was calculated based on WHO [14]: low (+) 1–10/100 fields, mild (++) 11–100/100 fields, mod-erate (+++) 1–10/one field, and high parasitaemia (++++) >10/one field.

**Hematological Analysis:** Blood samples were collected in EDTA vialsand tested in the laboratory. Determination of hematological parameters including hemoglobin (Hb) concentration, WBC count, lymphocytes, platelets, and packed cell volume (PCV) using automated hematology analyzer.

**Assays of Liver Functions Parameters:** Serum aspartate transaminases (AST) and alanine transaminase (ALT) parameters were determined. This assay was done following standard recommendations of the IFCC but was optimized for performance and stability by [15, 16]. Alkaline phosphatase (ALP) parameter was deter-mined using Roche/Hitachi systems automatically by colorimetric assay in accordance with a standardized method.

## Results

Of the 46 patients infected with *P. falciparum* 16% had low intensity of infection 1+ (1–10/100 fields), 30% had mild intensity of infection 2+ (11–100/100 fields), 25 % had moderate intensity of infection 3+ (1–10/one field), and 29 % had high intensity of infection 4+ (>10/one field) (Table 1). There were significant decreases in the mean values of the hemoglobin (Hb), packed cell volume (PCV), total leucocyte counts (tWBC), lymphocytes, and

platelets. Neutrophils were significantly higher in patients with *falciparum* malaria in comparison to standard normal values/ reference range.

**Table 1: Comparison of hematological parameters between the cases of *P. falciparum* malaria infection and reference range.**

| S.No | Parameters | Patients with malaria (Mean) | Reference Range (mean) |
|---|---|---|---|
| 1 | Hb (g/dL) | 11.6 gm/l | 14.5 gm/l |
| 2 | PCV (%) | 32% | 41% |
| 3 | T.WBC (per cumm) | 6000/cumm | 7500/cumm |
| 4 | Lymphocytes (%) | 20% | 31% |
| 5 | Neutrophils (%) | 62% | 60% |
| 6 | Platelet ($\times 10^3$/ L) | 1,20,000/cumm | 3,00,000/cumm |

**Table 2: Mean total and direct bilirubin levels in *parasitaemia* P.falciparum malaria.**

| Parasitaemia | Total bilirubin mg/dL | Direct bilirubin mg/dL | Indirect bilirubin mg/dL |
|---|---|---|---|
| Low | 2.30 mg/dl | 1.64 | 0.66 |
| Mild | 3.47 mg/dl | 3.00 | 1.47 |
| Moderate | 5.14 mg/dl | 4.10 | 1.04 |
| High | 8.68 mg/dl | 6.38 | 2.30 |

**Table 3: Mean liver enzymes levels in parasitaemia *P.falciparum* malaria patients**

| Mean parasitaemia/field | AST level (U/L) | ALT level (U/L) | ALP level (U/L) |
|---|---|---|---|
| Low (+) | 29.32 | 23.52 | 97.69 |
| Mild (+) | 35.36 | 26.89 | 139.8 |
| Moderate (+) | 59.63 | 48.27 | 198.4 |
| High (+) | 99.13 | 62.28 | 234.5 |

## Discussion

In this study, hemoglobin (Hb) and packed cell volume (PCV) decreased in *P. falciparum* affected patients compared. This finding agrees with previous reports [17, 18]. The earlier studies reported a significant reduction in hemoglobin concentration and packed cell volume in patients with malaria parasitaemia. In this study the mean hemoglobin concentration showed 9.3 g/dL, but, in the study done by Nadeem et al. [19], hemoglobin level in P. falciparum affected patients was 13.7 gm/dL. This value was more than that observed in our study. Reduced hemoglobin in malaria may be attributed to the increase of breakdown red blood cells by the parasites [20]. According to the report of Maina et al., as contained in the National Guidelines for Diagnosis Treatment and Prevention of Malaria for Health Workers in Kenya, anemia is defined as [Hb] < 10 g/dL for both males and females. Furthermore, severe malarial anemia is defined as [Hb] <5.5 g/dL. Therefore, the drop in hemoglobin concentrations in the malarious subjects in our study ranged between 5 and 10.5 g/dL, ranging approximately from mild to moderate anemia. In study done by Bakhubaira [21]

We found a significant increase in neutrophil countsin patients with *P. falciparum* malaria .Several reports [17,] have found similar findings. Low platelet count which is primarily an attribute of viral haemorrhagic fevers like dengue, may however be more common than anemia in falciparum malaria.

The results reported in this study show some significant increases in activities enzymes aspartate transaminase (AST), alanine transaminase (ALT), and alkaline phosphatase (ALP) among patients with *P. falciparum* malaria. The increased serum levels of hepatic enzymes, transaminases (AST and ALT), and ALP are the biomarkers of liver disorders. Our results are consistent with other studies which reported that majority of the patients show elevation in serum activities (AST, ALT, and ALP) indicating liver damage

## Conclusion

Acute falciparum malaria (irrespective of amount of parasitaemia) is associated with an increase in serum activity of AST and ALThighlighting the fact that the infection is associated with hepatic damage.Patients with moderate and high parasitaemia affects the Hemoglobin, platelet count, causes leucopaenia, and neutrophilia. Therefore, monitoring blood parameters and hepatic function is very important for therapeutic work up, as it enables the clinician to establish reliable and prompt diagnostic protocols and help ensure adequate therapeutic interventions and effective follow up.

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