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Original Research Article

Study of Hematological Profile of Malaria Patients at a Tertiary Care Hospital

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Abstract:

Background: India is one of the developing countries where malaria is the most lethal and contagious illness. Mosquitoes serve as the primary transmission vectors for this illness, which is brought on by Plasmodium parasite species. In order to quickly diagnose malaria, hematological tests such as RBC, WBC, and platelet parameters, as well as peripheral blood testing that changes depending on parasitaemia, must be examined in diverse malaria-affected regions. Early identification and treatment can help prevent unpleasant malarial consequences.

Methods: The current observational cross-sectional study was conducted to determine the hematological profile of malaria cases identified at D Y Patil Medical College in Navi Mumbai. With regard to clinical information, all patients with malaria who were sent to the Hematology department of the Department of Pathology were assessed. Data collection took place during a six-month period from October 2015 to March 2016. 50 cases of malaria were examined in total. On an EDTA blood sample, CBC/PBS testing was performed. The influence of malarial parasitaemia was investigated using the RBC parameters, WBC parameters, and platelet counts. The smear revealed a parasite index, and a fast kit test was used to confirm the diagnosis of malaria. The data was manually examined, and all the findings were entered into an MS-Excel sheet 2012.

Results: In the current investigation, P. vivax-related malaria predominated. In the current study, patients between the ages of 15 and 30 were more severely impacted, i.e., younger people. There was a male predominance. In the current investigation, fever was the most typical presenting symptom, followed by chills and rigor. Hb, RBC count, and PCV values that were below normal levels indicated that anemia was the most prevalent hematological alteration in the current study. Red cell indices, such as MCV, MCH, MCHC, RDW, and peripheral blood smear, all showed values within the normal range, indicating normocytic, normochromic RBCs in the current study. In the current study, patients with malaria who developed leucopenia after having normal TLC were more prevalent. The most frequent hematological alteration identified in this investigation was thrombocytopenia.

Conclusion: Measureable blood indicators known as hematological parameters are used to diagnose malaria.

Keywords: Malaria, Hematological profile, Complete blood count (CBC).

Introduction

In India and many other countries throughout the world, malaria is a serious health issue [1,4]. The spread of malaria is diverse throughout the Indian subcontinent and is influenced by a variety of climatic and physiological risk factors [4]. The World Health Organization (WHO) advises receiving a parasitological confirmation of diagnosis for all individuals of all ages in all epidemiological contexts with suspected malaria [5].

It is brought on by plasmodium-genus protozoa parasites, which infect and kill red blood cells (RBCs). Human malaria is brought on by the four plasmodium species P. vivax, P. falciparum, P. ovale, and P. malariae. The P. vivax parasite is a key contributor to cases in India. Due to the non-specific nature of the signs and symptoms, which greatly resemble other febrile illnesses typical of tropical settings, malaria is difficult to diagnose clinically [4].

Due to its affordability, microscopic slide examination of peripheral blood is typically the test that is utilized the most [6]. The "gold standard" for the routine diagnosis of malaria is widely acknowledged to be the microscopic detection and identification of plasmodium species in Giemsa or Leishman stained thick blood films (for screening) and thin blood films (for species confirmation)[5].

One of the most frequent malarial consequences is hemorrhaging, and this contributes significantly to the pathogenesis of malaria. Major cell types such RBCs, leukocytes, and thrombocytes are affected by these changes[6]. Human malaria infection is typically accompanied by a decrease in hemoglobin levels, which frequently results in anemia. The main cause of death from malarial infection is anemia, which is difficult to diagnose, especially when parasitaemia and the clinical picture can be mistaken for anaemia from other causes [2].

People who have malaria often have significantly lower numbers of platelets, white blood cells (WBCs), lymphocytes, eosinophils, red blood cells (RBCs), and HB, while having much higher quantities of monocytes and neutrophils than people who do not have the disease. The most frequent side effect of malaria infection is thrombocytopenia [6].

Material and Methods

A six-month, cross-sectional observational study was carried out at D Y Patil Medical College, Navi Mumbai from October 2015 to March 2016. The study included 50 (n=50) cases who tested positive for malaria by the fast malarial card test and on a peripheral smear, but excluded any cases who tested positive for other infectious disorders. Patients' complete medical histories, including their age, sex, illness type and duration, history of blood transfusions, clinical findings, and history of anti-malarial medication, were documented. Blood was drawn from the vena cava using EDTA vacutainers. Horiba's 5-part hematology analyzer was used to evaluate the following parameters in an EDTA sample: hemoglobin (Hb), packed cell volume (PCV) or hematocrit, RBC indices (MCV, MCH, MCHC), total leukocyte count (TLC), absolute leukocyte count, platelet count, and RDW.

Fresh blood was used to make the peripheral blood smear, which was then stained with Leishman stain for a blood image to assess the Differential Leukocyte Count (DLC), identify species, and estimate parasitaemia. A rapid malarial visual antigen test card was used to determine the species of plasmodium that was positive.

Results

Fifty cases of malaria in total were examined. Patients with P. vivax species malaria were 45/50 cases (90%) impacted, which was more common than P. falciparum, which was 4/50 instances (8%). There was only one incidence of mixed infection (2%). Patients between the ages of 15 and 30 were more likely to have malaria (42% of cases, or 21/50 cases). This was followed by those aged >45 years of age (30% cases or 15/50 cases) and 31-45 yrs (24% cases or 12/50 cases). No malarial cases were detected <5 yrs of age, while 6-14 yrs comprised 4% cases or 02/50 cases). Male predominance was seen with malaria infection (46/50 cases). Male: Female ratio of malarial infection was 11:5.

Table 1: Presenting signs and symptoms in different Malarial infections

Symptoms	Falciparum	Vivax	Mixed	Total	Percentage (%)
Fever	03	43	01	47	94%
Chills & Rigor	01	18	00	19	38%
Nausea	00	14	00	14	28%
Vomiting	00	09	00	09	18%
Abdominal pain	03	13	00	16	32%
Back pain	00	01	00	01	2%
Muscle pain	00	01	00	01	2%
Diarrhoea	00	05	01	06	12%
Cough	01	20	01	22	44%
Breathlessness	00	02	00	02	4%
Headache	02	13	00	15	30%
Fatigue	01	06	00	07	14%
Profuse sweating	00	05	00	05	10%
Hepatomegaly	01	00	00	01	2%
Hepatospleenomegaly	00	02	00	02	4%
Bloody stool	00	01	00	01	2%
Oedema	00	01	00	01	2%
Jaundice	00	01	00	01	2%

The most frequent presenting symptom of P.vivax and P.falciparum malaria was fever (94% of cases or 47/50 cases), which was followed by chills and rigor (38% of cases or 19/50 cases) and abdominal discomfort (32% of cases or 16/50 cases) (Table 1).

Table 2: Hb (Haemoglobin) concentration in malarial cases

Hb (gm/dl)	Vivax	Falciparum	Mixed	Percentage (%)
<5	00	00	01	02%
5-8	02	00	00	04%
8-10	39	04	00	86%
>10	04	00	00	08%

Patients with P. vivax and P. falciparum malaria exhibited Hb in the range of 8-10 gm/dl in about 86 percent (43/50 cases). This suggests that these patients had mild anemia (Table 2).

Table 3: Red Blood Cell (RBC) count in our malarial cases

RBC Count (millions/ cu.mm)	Vivax	Falciparum	Mixed	Percentage (%)
<3	03	00	01	8%
3-4	15	00	00	30%
4-5	24	03	00	54%
>5	03	01	00	08%

About 54% patients (27/50 cases) with P.vivax and P.falciparum had RBC count in a range of 4-5 millions /cu mm. 30% patients (15/50 cases) with P.vivax and P.falciparum had RBC count in a range of 3-4 millions /cu mm. 8% malarial patients (4/50 cases) had RBC count <3 millions /cu mm and >5 millions /cu mm, respectively (Table 3).

Table 4: HCT (Haematocrit) in percentage

HCT [%]	Vivax	Falciparum	Mixed	Percentage (%)
<20	01	00	01	04%
20-35	25	03	00	56%
>35	19	01	00	20%

P. vivax and P. falciparum were found in 56% (28/50 cases) of malaria patients, with hematocrits (HCT) ranging from 20 to 35%. Anemia was evident because 4% (2/50 instances) of malaria patients had malaria with hematocrits (HCT) < 20%. The remaining 20% (20/50 cases) of malaria cases had hematocrits of > 35% (Table 4).

Table 5: Mean Corpuscular Volume (MCV) (fL)

MCV (femtolitres)	Vivax	Falciparum	Mixed	Percentage (%)
<80	08	00	01	18%
80-100	37	04	00	82%
>100	00	00	00	00%

In 82% of the instances (41/40 cases), the MCV was between 80 and 100 fL. According to MCV criteria, this shows a normocytic population of RBCs in instances of malaria. 18% (9/50 instances) of the malaria cases had an MCV <80 fL. In our malarial patients, MCV > 100 fL/cell was not observed (Table 5).

Table 6: Mean Corpuscular Hemoglobin (MCH) (pg)

MCH (pg)	Vivax	Falciparum	Mixed	Percentage (%)
<27	10	01	01	24%
27-32	31	03	00	68%
>32	04	00	00	08%

MCH was more frequently observed in individuals with P.vivax and P.falciparum malaria in 68% of cases (34/50 instances), with a range of 27-32 pg. This shows that RBC normochromia according to MCH criteria is present. In relation to malarial patients, approximately 24% (12/50 cases) had MCH <27 pg while 8% (4/50 cases) had MCH >32 pg (Table 6).

Table 7: Mean Corpuscular Hemoglobin Concentration (MCHC) (%)

MCHC (%)	Vivax	Falciparum	Mixed	Percentage (%)
<31	03	00	00	06%
31-35	26	02	01	58%
>35	16	02	00	36%

In 58% of malarial cases (29/50 instances) in both P.vivax and P.falciparum affected patients, MCHC was observed in the usual range of 31-35 g/dl. This demonstrates RBC normochromia. In addition, 6% of malaria cases had MCHC values < 31 g/dl, while 36% had values >35 g/dl (Table 7).

Table 8: Red Cell Distribution width (RDW)

RDW (%)	Vivax	Falciparum	Mixed	Percentage (%)
10-15	37	04	00	82%
>15	08	00	01	18%

The RDW in 82% (41/50) of malaria patients was within the usual range of 10-15%, demonstrating that there was no anisocytosis in the RBC population. 18% (9/50 cases) of malarial patients had RDW of > 15% (Table 8).

Table 9: Red cell morphology on peripheral smear in malaria species

Blood picture	P.vivax	P.falciparum	Mixed	(%)
Normocytic normochromic	32	3	0	70%
Normocytic hypochromic	4	0	0	8%
Microcytic hypochromic	4	1	1	12%
Macrocytic	4	0	0	8%
Dimorphic	1	0	0	2%

The RBC morphology of individuals with malaria caused by both P. vivax and P. falciparum was predominately normocytic normochromic (32/50 instances or 70% of cases). In 12% (6/50) of the cases, the RBC picture was microcytic hypochromic, while in 8% (4/50) of the P. vivax cases, the RBC picture was macrocytic (Table 9).

Table 10: Parasite count (%) with respect to type of malaria

Parasite count In %	Vivax	Falciparum	Mixed	Percentage (%)
<1	25	01	01	54%
1-5	18	03	00	42%
>5	02	00	00	04%

27/50 cases, or 54% of malaria patients, had parasite indices <1%, indicating low parasitaemia. (21/50 instances) of malaria patients had parasite indices between 1% and 5%, which indicates low parasitaemia (Table 10). No clear relationship between a high parasite index and a more severe case of thrombocytopenia, or vice versa, was seen in our investigation.

Table 11: White blood cell count (cells/cu.mm)

Total Leucocyte Count cells/mm3	Vivax	Falciparum	Mixed	Percentage (%)
<4000	09	00	00	18%
4000-11,000	33	04	01	76%
>11,000	03	00	00	06%

In 76% (38/50 cases) of patients with P.vivax and P.falciparum affected malaria, the TLC (Total Leucocyte Count), or between 4000 to 11000/cu mm, was within the normal range. Leukopenic malarial cases with TLC 4000 cu mm were found in 18% (9/50) of the patients after that. The cause of all of these 18% instances was P. vivax. This suggests that leucopenia was seen more frequently after P. vivax infection than the typical TLC range. Leukocytosis with TLC >11000/ cu mm was seen in just 6% (or 3/50) of malaria cases. P. vivax infection was the cause of all of these 6% of cases. P. vivax was the sole cause of leucopenia and leukocytosis in our investigation (Table 11).

Table 12: Absolute counts of types of WBCs in malarial cases

Absolute Count	Vivax	Falciparum	Mixed	Percentage (%)
Neutrophilia	12	00	00	24%
Neutropenia	07	01	01	18%
Lymphocytosis	10	01	01	24%
Eosinophilia	05	00	00	10%
NormalCount	11	02	00	13%

Neutrophil and lymphocytosis were most frequently observed in malaria patients who tested positive for P. vivax (24% of each, or 12/50 cases). Based on absolute counts, P. falciparum cases primarily displayed neutropenia and lymphocytosis (Table 12).

Table 13: Platelet Count in Malarial cases

Platelet Count/mm3	Vivax	Falciparum	Mixed	Percentage (%)
<50,000	20	00	00	40%
50,000-1.5 lakhs	24	04	01	58%
>1.5lakhs	01	00	00	2%

In 58% (29/50 cases) of patients with malaria of P.vivax and P.falciparum were having platelet count in a range of 50,000 – 1.5 lakhs/ cu mm of blood. Platelet count was <50000/cu mm in 40%

(20/50 cases) malarial cases. This indicates thrombocytopenia was present in majority of malarial cases. Only 2% malarial cases had normal platelet count due to earlier diagnosis (Table 13).

Discussion

Since ancient times, there has been malaria, and it was first recognized in 4 BC. Malaria endemicity levels differ from nation to nation. Alphonse Lavern, a French army surgeon, discovered and named the malaria parasite in human RBCs in Algeria in 1880. Italian researchers discovered that female Anopheles mosquitoes of the species transmit human malaria in 1898[2].

Clinical and epidemiological investigations were aided by the severe malaria criteria set forth by the World Health Organization (WHO). This study was started in 1990, and it was amended in 2000 to include additional clinical symptoms and lab results that, according to clinical experience with semi-immune patients [7], portend a bad prognosis.

More than 2.4 billion people worldwide are at risk, and more than 100 nations are deemed to be dangerous. About 300–500 million cases of malaria are thought to occur annually throughout the world. Between 1.1 and 2.7 million people each year die from malaria, the majority of whom are children under the age of five [1].

The human cycle (asexual cycle) and the mosquito cycle (sexual cycle) are the two developmental cycles that the malarial parasite goes through. The mosquito is the primary host, while man is the intermediate host [1-3]. Although fever and other symptoms are recognized to be sensitive indicators of malaria infection, they lack specificity and have a poor ability to forecast the future, particularly in regions where the disease is less common. As a result, it could be challenging to identify malarial sickness from other viral and bacterial infections [6].

It is anticipated that malaria parasites will have an impact on haematological parameters since they can adhere to receptors on the surfaces of red blood cells [8,9]. Haematological parameters are quantifiable blood indicators that are used to diagnose diseases [3].

Severe chronic anemia, red cell degeneration, thrombocytopenia, mild to moderate atypical lymphocytosis, leucopenia, leukocytosis, eosinophilia, neutrophilia, and monocytosis are some of the variable haematological alterations seen in malaria [4,5,8].

In a South Indian study, plasmodium vivax infection was more common (92%), compared to plasmodium falciparum infection (8%). The infection caused mild thrombocytopenia and anemia in the victims. Infections with vivax and falciparum were significantly associated with thrombocytopenia and anemia, respectively [3].

Peripheral blood smears, including thick and thin smears, are used in the laboratory to diagnose malaria. Quantitative buffy coat technique (QBC), antigen detection techniques, PCR, ELISA, and indirect Fluorescent Antibody Test (IFAT) are more expensive alternatives to the "gold standard" test of microscopy. Due to financial limitations and the country's dense population, alternative testing are not practical in any lab setup in India.

In the current investigation, P. vivax-related malaria predominated. This result was consistent with those of other studies [1,3,6,8]. Younger persons, particularly those between the ages of 15 and 30, were more influenced by the current study. These results agreed with those of other studies [1,3,6,8,10]. In the current study, men outnumbered women, which was consistent with other studies cited earlier [1,3,6,8,10].

In the current investigation, fever was the most typical presenting symptom, followed by chills and rigor. These results were in line with those of the previous studies mentioned [1]. Hb, RBC count, and PCV values that were below normal levels indicated that anemia was the most prevalent hematological alteration in the current study. Similar results were seen in other studies [1,3,4,6,8,10].

In the current study, 70% of malarial cases had normocytic normochromic RBCs as detected by peripheral smear. In 82%, 68%, and 58% of our malarial cases, the MCV, MCH, and MCHC were all within normal range. Similar characteristics were found in other studies [1]. In a few investigations on malaria, it was found that MCV and RDW levels were greater than usual [4,6,8].

In the current study, patients with malaria who developed leucopenia after having normal TLC were more prevalent. Similar results were shown by other studies [1,8]. Few studies [2, 10] demonstrated decreased leukocyte counts in malaria cases. In a single study, malaria sufferers had higher WBC counts than controls [11]. The most frequent hematological alteration identified in this investigation was thrombocytopenia. The majority of the other studies [1,3,4,6-8,10] found anything similar. Blood clotting problems, splenomegaly, bone marrow changes, antibody-mediated platelet destruction, oxidative stress, and the role of platelets as cofactors in causing severe malaria are some of the hypothesized processes causing thrombocytopenia in malaria[8,11].

Conclusion

Malaria and other endemic illnesses can have an impact on hemological alterations. Since anemia and thrombocytopenia are the most often detected

haematological abnormalities, they may be used as indicators of malaria infection. Numerous haematological abnormalities can aid in the diagnosis of malaria, enabling clinicians to administer the proper medication and prevent serious malarial consequences.

Patients with P. vivax- and P. falciparum-caused malaria experienced similar effects on many haematological markers. Haematological tests are reasonably priced, trustworthy, and capable methods to determine the severity of malaria.

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