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Assessment of Hematological and Biochemical Abnormalities in Malaria Patients: Insights from a Cross - Sectional Observational Study

Anudeep D[1], Singampalli M[2], Kumar AE[3]

[1]M. D. General Medicine, Senior Resident, GEMS Medical College, Srikakulam
Corresponding Author Email: *devarapallianudeeep21[at]gmail.com*
+917207218283

[2]M. B. B. S Junior Resident, G. M. R Varalakshmi Care Hospital

[3]M. D General Medicine, Consultant, Bhavani Multi Speciality Hospital and Laparoscopic Hospital

Abstract: ***Background: Inspite of worldwide efforts to reduce malaria transmission, it is still the major cause of mortality and morbidity, with an overall fatality rate of 10 - 30%. Hence present study was taken up to assess the haematological abnormalities and biochemical abnormalities in patients with malaria. Methods: This is a cross sectional observational study done inpatients admitted in G. S. L Medical College & General Hospital in patients with clinical and laboratory evidence of malaria from October2018 to June 2020. Results: Out of the total (75) study population, 41 (54.6%) patients had Vivax malaria, and 34 (45.4%) had Falciparum malaria. Fever was the presenting symptom in all 75 (100%) patients. The duration of hospital stay was more in patients infected with falciparum than vivax, and there was a statistically significant difference (p<0.05) between these study groups. Conclusion: Malaria has a significant impact on the biochemical profile; therefore, these parameters can be used as a measure to evaluate organ dysfunction in severe acute malaria.***

Keywords: Malaria, Anaemia, Falciparum, Vivax.

1. Introduction

Malaria is a protozoan disease caused by Plasmodium species (P. Falciparum, P. Vivax, P. Ovale, P. Knowlesi), which is transmitted by the bite of infected female anopheles mosquitoes occur through tropics and subtropics at altitudes below 1500 meters[1].

Inspite of worldwide efforts to reduce malaria transmission, it is still the major cause of mortality and morbidity, with an overall fatality rate of 10 - 30% was seen[3].

Malaria affects almost all the organs of the body. But the most commonly affected system is blood. Malaria remains a major cause of mortality in the tropical world, with as many as 500 million cases annually[2].

Due to the association between the parasites and red cells, there are numerous consequences to the host's blood extending far beyond the direct effect of parasitized red blood cells, including severe anaemia, coagulation disturbances, leucocyte changes, and spleen involvement[3.]

Thrombocytopenia is one of the most persistent features of severe malaria, found in approximately 50–80% of malarial patients[4.] White blood cell counts during malaria are generally characterized as being low to normal.5Hypoglycemia, an important and common complication of severe malaria, is associated with a poor prognosis and is particularly problematic in children and pregnant women.6Total and direct bilirubin and serum urea had a good discriminatory performance for severe vivax malaria.1

Aim & Objective:

1) To assess the haematological abnormalities in patients with malaria
2) To assess the biochemical abnormalities in patients with malaria
3) To correlate haematological abnormalities in association with outcome/mortality.

2. Methodology

This is a cross sectional observational study done inpatients admitted in G. S. L Medical College & General Hospital in patients with clinical and laboratory evidence of malaria from October2018 to June 2020.

All patients who were above 18 years of age and had confirmed smear positive malaria cases by peripheral blood film examination were taken up, while patients on medications affecting haematological parameters or patients with chronic liver or kidney disease were excluded from the study. Relevant clinical history and general physical examination were taken from every study participant. The investigations like complete blood picture, coagulation profile, renal function tests, liver function tests, random blood sugar were carried out in all the study subjects. Written and informed consent was obtained from every study subject. Institutional review and ethics committee approval was obtained before commencing the study. Statistical analysis was done by using SPSS software version 20.0. P values < 0.05 were considered statistically significant.

3. Results

The mean age of this study group was 40.7 years. The present study included 75 patients, out of which male patients were42 (56%), and female patients were 37 (44 %). There was a male preponderance, and the Male to female ratio was 1.27: 1.

Out of the total (75) study population, 41 (54.6%) patients had Vivax malaria, and 34 (45.4%) had Falciparum malaria. Fever was the presenting symptom in all 75 (100%) patients.

The mean Hb level was 8.44 gm% (SD ± 1.9). Inthe present study, anemia was found in 49 (65.3%) of patients. In the present study, 29 (38.7%) patients developed microcytic hypochromic anemia, out of which falciparum patients and vivax patients contributed 72.4% and 27.5%, respectively. Splenomegaly was observed in 25.3% of patients, and the majority of patients with splenomegaly had anemia.

In the present study, thrombocytopenia with splenomegaly was observed in 25.5% of patients. Out of 47 patients who had thrombocytopenia, only 25.5% (12) had splenomegaly. However, no statistical correlation could be established between the incidence of thrombocytopenia and splenomegaly in malaria in the present study. (p=< 0.95).

Prothrombin time was increased by 44 (58.7%) patients. Amongthese patients, 20 (45.5. %) were infected with falciparum, 24 (54.5%) were infected with vivax. The mean P. T. was 15.22± 4.5 seconds.

In the present study, the Mean APTT was 31.4 ± 6.5 seconds. It was increased in a total of 8 (10.7%) patients. It was found to be increased more in vivax infected 5 (62.5%) than falciparum - infected 3 (37.5%) patients.

Mean bleeding time was 6.034 ± 2.11 min. Bleeding time was increased in a total of 13 (17.3%) patients in this study. Out of which, it was seen in 4 (30.8%) falciparum cases and 13 (69.2%) vivax cases.

In the present study, mean Creatinine was 1.29 ± 0.95 mg/dl. Increased Creatinine was found in 12 (16%) of the total population. Out of which, 9 (26.4%) were infected with Falciparum, and 3 (7.31%) were infected with Vivax. Among patients with normal serum creatinine, the mean duration of hospital stay was 6.8 ±1.94 days, and the range was 5 - 14 days, and in patients with increased serum creatinine, the mean duration of hospital stay was 9.14 ± 1.83 days, and the range was 6 - 12 days. The duration of hospital stay was increased in patients with increased serum creatinine when compared to patients with normal serum creatinine, and there was a statistically significant correlation (p=0.000073) between these study groups.

The mean Blood urea was 41.38 ± 23.03mg/dl. Increased Blood urea was seen in 12 (16%) of total patients. Out of these 12 patients, 9 (26.4%) were infected with Falciparum, and 3 (7.31%) were infected with Vivax. In patients with normal blood urea, the mean duration of hospital stay was 6.76 ±1.99 days, and the range was 5 - 14 days, and in patients with increased blood urea, the mean duration of hospital stay was 8.65 ± 1.95 days, and the range was 6 - 12 days. The duration of hospital stay was increased in patients with increased blood urea when compared to patients with normal blood urea, and there was a statistically significant correlation (p=0.000073) between these study groups.

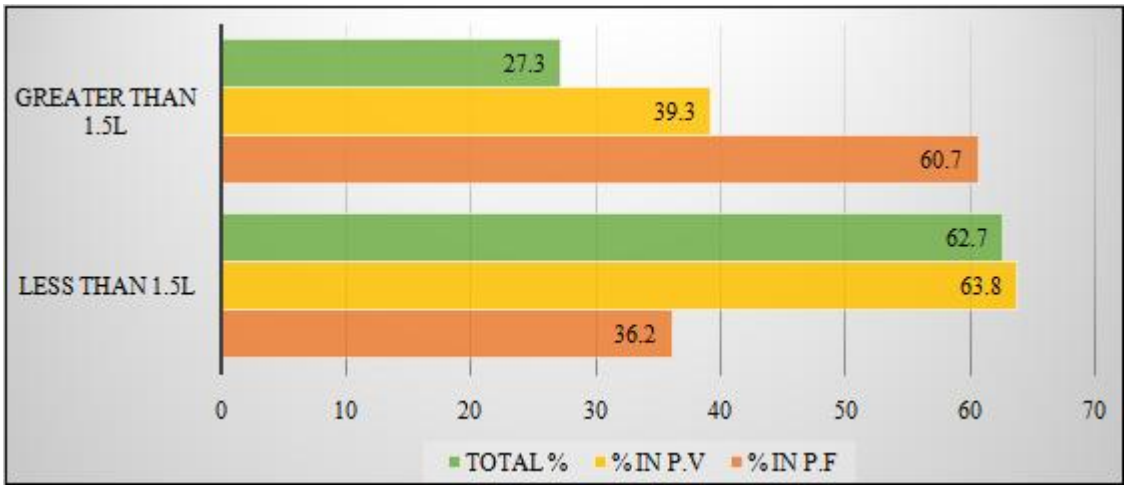
In the present study, the mean duration of hospital stay was 7.26 ± 2.37 days, and the range was 5 - 14 days in total subjects. In patients among the falciparum group, the mean duration of hospital stay was 8.37 ± 2.65 days, and the range was 6 - 14 days. In patients among the vivax group, the mean duration of hospital stay was 6.39 ± 1.4 days and the range was 5 - 11 days. The duration of hospital stay was more in patients infected with falciparum than vivax, and there was a statistically significant difference (p<0.05) between these study groups.

Table 1: Grades of anemia

Haemoglobin (g/dl)	Number of total study subjects	Number of subjects with anemia in P. F group	Number of subjects with anemia in P. V group	P value
9 to 11 (Mild)	21 (42.8%)	11 (52.3%)	10 (47.6%)	p>0.05
7 to 9 (Moderate)	25 (42.8%)	17 (68%)	8 (32%)	P < 0.05
<7 (Severe)	3 (6.1%)	3 (100%)	0 (0.0%)	P<0.001

Table 2: Association of Anemia and splenomegaly

Anemia	Splenomegaly		Total	P - Value
	Present	Absent		
Present	18	31	49	<0.5
Absent	1	25	26	
Total	19	56	75	



Graph 1: Incidence of thrombocytopenia in Falciparum and Vivax

Table 3: Incidence of Deranged Liver function tests in Malaria

Liver Function Tests	Total (N=75)	P. F (N=34)	P. V (N=41)
T. Bilirubin	18 (24%)	12 (35.2%)	6 (14.63%)
D. Bilirubin	18 (24%)	13 (38.2%)	5 (12.1%)
I. Bilirubin	30 (40%)	15 (44.1%)	15 (36.5%)
SGOT	11 (14.6%)	8 (23.5%)	3 (7.31%)
SGPT	11 (14.6%)	8 (23.5%)	3 (7.31%)

Table 4: Correlation of Duration of Hospital Stay withAnaemia

Haemoglobin	Number of Patients	Mean Duration of Hospital Stay (In Days)	Range	P - value	t - Value
>11	26	6.16 ± 1.23	5 - 14		
< 7	3	8.33 ± 0.577	8 – 9	0.006	2.948
7 - 9	25	8.14 ± 2.34	6 - 13	0.005	3.698
9 - 11	21	7.32 ± 2.30	6 - 14	0.054	1.979

4. Discussion

In the present study, the incidence of vivax malaria was higher at 54%, and falciparum malaria was 46 %. In the study conducted by Alberto Tobón - Castañoet al[7]., with a study population of 888, the incidence of P. falciparum malaria was 62.6% (556), andP. vivax was 35.2% (313), and with both the species 2.1% (19). In a study conducted by Arevalo et al[8], Incidence of vivax was 50.7%, and falciparum was 48.9%, with both species in 0.4%. In another study conducted by Nefsu awoke et al[9]. on a study population of 170, the incidence of Falciparum malaria was 61.7% (105), Vivax was 36% (61), and mixed infection was 2.3% (4). From the above studies, we can conclude that the incidence of malaria with particular species varies with a geographical area.

Hematological abnormalities are considered as hallmark of malaria and reported to be most pronounced in Falciparum infection, probably due to the higher levels of parasitemia found in these patients. The observations made inthe present study show that in acute malaria, there were peripheral blood changes, including anemia, which was observed in 65.3% of total patients, with predominance in falciparum cases of 63.2% (31) compared to vivax with 36.7% (18). In a study conducted by Yadav RK et al[10]., 80% of patients hadanemia, out of which 21% of patients were infected with Vivax, 48% were infected with falciparum and 11% infected with both species.

In the present study, 61.3% ofthe patients had normocytic normochromic blood picture comparable to a study conducted by Sen et al[11]., which showed about 50% of the patients had normocytic normochromic blood picture. Also, 38.7% of the patients had a microcytic hypochromic blood picture in contrast to 20% in a study conducted by Sen et al[11]This is perhaps due to the prevalence of iron deficiency anemia in our country. In the study conducted by Sen et al[11]the prevalence of dimorphic anemia was 30%.

The percentage of patients with lymphocytosis in this study was 18.7%. But in other Studies, it was very low compared to this study. In a study conducted by Alberto - Tobon et al[12]., lymphocytosis was observed only in 2%, and in a study done by Vaidya MS et al[13]., it was only 3.8% of the total. Lymphocytosis observed in this study is very high, but in other studies, it was very low.

Percentage of patients with thrombocytopenia was 62.7%, out of which 36.2% were due to falciparum, and 63.8 % were due to vivax malaria. Thrombocytopenia had a high prevalence in this study, which is supported by previous studies[13 14 15]; it gives a clue that malaria can be considered as a differential diagnosis for other acute febrile illness with thrombocytopenia, and can also be used as asupportive diagnostic criterion for malaria, in situations where the microscopic diagnosis is not sufficient, as in cases of low parasite density.

Only 12 patients (25.5%) had thrombocytopenia with splenomegaly. So, it can be concluded that thrombocytopenia is not entirely caused by splenic sequestration.

In the present study, prothrombin time wasprolonged in 58.7% of total patients and in 45.5% of falciparum cases. In a study conducted by Jayashankar CA et al[16]., PT was prolongedin about 34% of total cases, out of which 73.3% of them had falciparum malaria infection.

The present study concluded that malaria has a significant impact on the biochemical profile (liver and renal function tests); therefore, these can be used as a measure to evaluate organ dysfunction in severe acute malaria. It can be considered as a leading differential diagnosis in acutely febrile patients with more abnormalities, including splenomegaly and hepatomegaly.

In the present study, patients with severe anaemia (Hb<7 g/dl) had an increased mean duration of hospital stay of 8.33 ± 0.57 days, which was statistically significant (p=0.006) when compared to non - anemic patients (6.16±1.23 days). In a study conducted by Diana et al[17]., in patients with severe anaemia, mortality was seen in 2.6% of patients, and the mean duration of hospital stay was 8.5 days, which was prolonged when compared to normal subjects (3.4 days). In a study conducted by Kavitha S et al.[18], severe anaemia was seen in 50% of patients and was associated with an increased risk of hospitalization of more than seven days, and there was statistically significant difference compared to non - anaemic patients (p<0.001). The present study was in concurrence with the above studies.

5. Conclusion

Malaria has a significant impact on the biochemical profile; therefore, these parameters can be used as a measure to evaluate organ dysfunction in severe acute malaria. Splenomegaly is an important sign in malaria, but its absence does not rule out malaria. A statistically significant increase in the duration of hospital stay in patients with abnormal haematological and biochemical parameters with anaemia being the commonest suggests an increase in morbidity.

Limitations: Study sample size is small.

Conflicts of interest: Nill

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