

ORIGINAL ARTICLE

HEMATOLOGICAL CHANGES IN P.FALCIPARUM & P.VIVAX MALARIA

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ABSTRACT

Introduction: Malaria continues to be a great health problem in some of the most populated areas of the world & continues to cause significant morbidity and mortality worldwide. The hematological abnormalities that have been reported to consistently with malaria are anemia, thrombocytopenia, atypical lymphocytosis and infrequently disseminated intravascular coagulation.

Methodology: This cross sectional study was conducted in central hospital laboratory of a tertiary care hospital of Surat, Gujarat. The laboratory confirmed cases of malaria from August to October, 2012 were included in the study. Hematological profile of different species of malaria was compared.

Results: The difference in mean platelet count according to severity of infection was highly statistically significant according to ANOVA test both for P.Vivax and P.Falciparum. Platelet counts show decreasing trend according to severity of infection. Difference in the mean haemoglobin level and mean platelet counts of P.Vivax cases and P.Falciparum cases was also statistically significant.

Conclusion: The low level of platelet can be used as predictor of severity of the infection. And thus, prediction of the hematological changes enables the clinician to establish an effective and early therapeutic intervention in order to prevent the occurrence of major complications.

Keywords: Plasmodium Falciparum, Plasmodium Vivax, Haematological Profile, Malaria

INTRODUCTION

Malaria is well-known to human being since centuries; it is a disease of tropical and subtropical countries particularly Africa and Asia. It is caused by protozoan *Plasmodium*, transmitted by female anophel mosquitoes, which typically bite between dusk and dawn.

Malaria continues to be a great health problem in some of the most populated areas of the world & continues to cause significant morbidity and mortality worldwide. As per world malaria report 2009, half of the world's population is at risk of malaria and an estimated 243 million cases led to nearly 8,63,000 deaths in 2008.¹

In India, total 1.49 million malaria cases had occur. Out of which, 0.77 million (52.12%) cases were of P.Falciparum in year 2010. Annual parasite infection (API) of India for the year 2010 was 1.3. Annual Blood Smear Examination Rate (ABER) of India for the year 2010 was 9.21.

Hematological changes, which are the most common systemic complications, play a significant role in these serious complications. The hematological abnormalities that have been reported to consistently companion

which comprise anemia, thrombocytopenia, atypical lymphocytosis and infrequently disseminated intravascular coagulation.² Leucopenia, leucocytosis, Neutopenia, Neutrophilia, Eosinophilia and monocytosis also have been reported.^{3,4} In tropical countries like India, the majorities of the shared complications commencing due to malarial consequences is from hyperparasitemia. Mortality is very high (10- 30%) in complicated *P. falciparum* infection.

This study aimed to evaluate and determine of various hematological alterations in patients infected with malaria and to add more detailed information, especially from these highly affected zones. The level of parasitemia was also assessed and correlated with these haematologic changes.

METHODOLOGY

The present comparative cross sectional study was conducted in central hospital laboratory of a tertiary care hospital named Surat Municipal Institute of Medical Education and Research (SMIMER) of Surat, Gujarat. The laboratory confirmed cases of malaria

from August to October, 2012 were included in the study. The diagnosis of malaria was confirmed thick blood films stained with GIEMSA stain for malaria parasite and Antigen Histidine Release Protein 2 (HRP2) test. Complete Blood Count was performed using an automated cell counter and WBC differential was also done for all patients. All malaria positive smears were studied for confirmation, identification of species and review of smear for platelets count and other hematological changes. Data was analyzed by Epi.Info Statistical Software. *p* value of < 0.05 was taken as significant for all statistical analysis.

Besides history taking, clinical examination, and routine laboratory work, thick blood films were prepared and examined for defining the species involved. Minimum of 200 fields (oil immersion) were assessed to label a negative smear. The percentage and grading of parasitemia was done after counting schizonts, ring and amoeboid forms in oil immersion on thin smears. Anemia and thrombocytopenia were labeled when hemoglobin (Hb) was < 11.0 g% and platelet counts were <1.5 lakhs/mm³, respectively. The results were compared with normal standards.

RESULTS

Out of total 1445 patients of malaria, 841(59%) had P. Falciparum, 591(41%) had P.Vivax infection &

13(0.9%) had mixed infection. Normal platelet count was observed in 259(18%) patients while the thrombocytopenia was observed in 1186(82%) cases. Of which 305(25%) had mild, 559(46%) had moderate & 353(29%) had severe thrombocytopenia. Thrombocytopenia was found in 479(41%) cases of P. Vivax & 695(59%) of P. Falciparum infection.

Table 1 shows haematological profile of P.Vivax cases according to different grade of severity of infection. Severity increases from grade 1 to grade 4. During the study period of three months, total 591 patients were having only P.Vivax infection. Out of these, maximum numbers (36.55%) of patients were from grade 3. Total 135 (22.84%) patients were from grade 1 severity and 11.50% of patients were of most severe P.Vivax infection. Table 1 shows Total WBC count and Platelet count of different grades of disease. There was no specific pattern for Total WBC count for different grades of P.Vivax infection. But as the severity increases the platelet count decreases. The mean of platelet count of most severe infection of P.Vivax cases were lowest (77,661). And mean of platelet count of grade 1 infection i.e. of least severe infection of P.Vivax were highest (1,20,288). On applying ANOVA test on mean platelet levels of different grades of infection, the result shows that the difference in the platelet count is highly significant (p-Value <0.00001). This proves that, platelet count of the patient decreases with increase in severity.

Table 1: Haematological Profile of P.Vivax Cases

P.Vivax grade	Number of Patients (%)	Total WBC count Mean±SD	Platelet count Mean±SD
1	135 (22.84)	6760.74±3353.95	1,20,288±79,490
2	172 (29.10)	6904.65±3201.73	1,01,040±60,007
3	216 (36.55)	6458.80±3291.40	92,120±50,179
4	68 (11.50)	6551.47±3112.01	77,661±47,260
Total	591 (100)	6668.19±3257.20	99,487±61,800

p-Value <0.00001 (for Platelet Count for different grades of P.Vivax Cases) (ANOVA Test)

Table 2: Haematological Profile of P.Falciparum Cases

P.Falciparum grade	Number of Patients (%)	Total WBC count Mean±SD	Platelet count Mean±SD
1	235 (27.94)	6729.36±3806.89	1,09,700±68,503
2	151 (17.95)	6000.00±3291.06	97,483±56,776
3	217 (25.80)	5881.11±3307.97	92,506±58,015
4	238 (28.30)	6732.35±4776.59	70,130±46,352
Total	841 (100)	6380.38±3921.99	91,871±59,900

p-Value <0.00001 (for Platelet Count for different grades of P.Falciparum Cases) (ANOVA Test)

Table 2 shows distribution of P.Falciparum cases according to severity of infection. The maximum numbers of cases i.e. 238 (28.30%) were having of most severe infection. And 27.94% patients were having least severe infection. As observed for P.Vivax infection, the total WBC count did not show any pattern according to severity of P.Falciparum infection. Here also, platelet counts show decreasing trend according to severity of infection. Mean platelet count of total 238 patients of grade 4 i.e. most severe P.Falciparum infection was 70,130 with standard deviation of 46,352. Where as,

mean platelet count was highest of grade 1 P.Falciparum cases. This difference in mean platelet count according to severity of infection was highly statistically significant according to ANOVA test (p-Value <0.00001).

Table 3 shows mean haemoglobin level and platelet count of different species. Mean haemoglobin level of P.Vivax positive patients was 10.26 gm/dl with standard deviation of 2.55 gm/dl. Whereas, mean haemoglobin level of P.Falciparum positive patients was 9.78 gm/dl with standard deviation of 2.83 gm/dl. This difference

was statistically significant (p-Value = 0.001). Difference in the mean platelet counts of P.Vivax cases and P.Falciparum cases was also statistically significant (p-Value- 0.0195)

Table 3: Comparison of Haemoglobin Level and Platelet Count of Different Species of Malaria Infection

Species	Cases	Hb (gm/dl) Mean±SD	Platelet count Mean±SD
P.Vivax	591	10.26±2.55	99,487±61,800
P.Falciparum	841	9.78±2.83	91,871±59,900
p-Value		0.0010	0.0195

DISCUSSION

Data of malaria cases from tertiary care hospital from three months of duration shows that out of total 1445 patients of malaria, 841(59%) had P. Falciparum and 591(41%) had P.Vivax infection. Whereas, 13(0.9%) had mixed infection. Thus, during study period maximum numbers of cases were of P.Falciparum malaria. This indicates high proportion of P.Falciparum infection during the season. This finding was in consistent with national data which shows for 2010 year, P.Falciparum cases were of 52% of total malaria cases.

There are many studies which indicates that precise haematological changes may vary with category of malaria with the background of haemoglobinopathy, nutritional status, demographic factors and malaria immunity.⁵ We observed in our study several significant changes concerning with haemoglobin and platelets. Mean haemoglobin level of P.Vivax and P.Falciparum patients was 10.26 gm/dl and 9.78 gm/dl respectively. Many studies shows that anaemia is associated with malaria infection and mostly of normocytic normochromic type.^{6,7}

The pathogenesis of anaemia in malaria is particularly complex and incompletely understood. It is thought to result from a combination of hemolysis of parasitized red blood cells; accelerated removal of both parasitized and innocently un-parasitized red blood cell, depressed as well as ineffective erythropoiesis with dys-erythropoietic changes and anemia of chronic disease.^{8,9} Other factors causative to anemia in malaria include decreased red blood cell deformability, splenic phagocytosis and/or pooling, so they have an increased rate of clearance from the circulation.¹⁰ Tumour necrosis factor alpha (TNF- α) has also been implicated and may cause ineffective erythropoiesis. Nonnormocytic normochromic pattern was observed as the predominant type of anaemia and it correlate with the degree of parasitemia.¹¹

Our study shows that thrombocytopenia was present in many of the cases. But important finding is as the severity of infection increases the platelet count decreases in both P.Vivax and P.Falciparum infection.

On applying ANOVA test on mean platelet levels of different grades of infection, the result shows that the difference in the platelet count is highly significant. This proves that, platelet count of the patient decreases with increase in severity for both P.Vivax and P.Falciparum infection. The reduction in circulating platelet count are consistently reported in the different types of malaria.¹²

Our study shows that difference in the mean platelet counts of P.Vivax cases and P.Falciparum cases was statistically significant (p-Value- 0.0195). The possible mechanisms leading to thrombocytopenia in malaria can be immune mechanisms, oxidative stress, alterations in splenic functions and a direct interaction between plasmodium and platelets. The mechanism which might be a causative factor for thrombocytopenia in *P. falciparum* and *P. vivax* infection could be Peripheral destruction, induced by *P. falciparum*, in which immune complexes generated by malarial antigens lead to sequestration of the injured platelets by macrophages in the spleen, although this mechanism has not been properly evaluated in *P. vivax* malaria.¹³ Some workers have suggested Disseminated Intravascular Coagulation (DIC) as a major mechanism, but others have found no evidence or have hardly ever seen DIC in any of their patients, including those with severe thrombocytopenia.¹⁴ In acute malaria infection platelets are found to be hypersensitive and there is increased concentrations of platelet-specific proteins such as beta thromboglobulin (β TG), platelet factor 4 (PF4). Production of thromboxane A₂ and prostacyclin also increased. It has also been postulated that these hypersensitive (hyperactive) platelets will enhance haemostatic responses, and may be this is why bleeding episodes are rare in acute malarial infections, despite the significant thrombocytopenia.¹⁵

Thus, our study shows that as the severity of infection increases the platelet count decreases in both P.Vivax and P.Falciparum infection. There is a statistically significant difference in the mean haemoglobin level and mean platelet counts of P.Vivax cases and P.Falciparum cases. And thus, prediction of the hematological changes enables the clinician to establish an effective and early therapeutic intervention in order to prevent the occurrence of major complications.

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