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Original Article

Pathology Section

Hematological Parameters in Plasmodium Vivax and Falciparum Malaria-A Study At Tertiary Care Centre in North Karnataka

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ABSTRACT

Background: Worldwide, malaria is a major health problem having high morbidity and mortality. Early diagnosis and treatment prevents complications. The laboratory diagnosis of malaria mainly includes microscopic study of peripheral smear. In the present study, thrombocytopenia and alteration in hematological parameters was observed in malaria infected patients.

Study design: Retrospective case study and review of literature.

Methods: Seventy five cases of peripheral smear proven malarial infection, common species being plasmodium vivax (n= 66) and nine cases of plasmodium falciparum were included in this study. Clinical features, peripheral smear and hematological parameters including hemoglobin concentration, total leukocyte count, platelet count and mean platelet volume of all the patients were collected and studied.

Results: Thrombocytopenia was the most common abnormality noted in 71 (94.66%) of 75 cases. Among those who were infected by P. falciparum, one case had severe thrombocytopenia while eight (88.88%) had moderate thrombocytopenia. In case of P. vivax infection four (06.06%) patients had severe thrombocytopenia while 51(77.27%) had moderate degree of thrombocytopenia. An increase in mean platelet volume was seen in 19 vivax infected cases (28.78%). Anemia was present in 5 cases of P. falciparum and 25 cases of P. vivax infection. Leucopenia was observed in four and 23 cases of P. falciparum and P. vivax respectively.

Conclusion: In the present study, malaria infection by P. vivax was more common than P. falciparum species. Thrombocytopenia, leukopenia and anemia were commonly observed hematological abnormalities noticed amongst the study population. A finding of thrombocytopenia and anemia in a febrile patient should raise the suspicion of malaria hence further specific tests can be employed for confirmation.

Keywords: Malaria, Plasmodium falciparum, Plasmodium vivax, Thrombocytopenia, Leucopenia, Anemia

INTRODUCTION

Malaria is a mosquito-borne, hemolytic, febrile illness that leads to 219 million documented cases of malaria around the world in 2010. The disease killed 660 000 to 1.2 million people in the same year [1]. India contributes 77% of total malaria cases in South east Asia with estimated 1000 deaths annually [2]. Four species of Plasmodium causing malaria are P. falciparum, P. vivax, P. ovale, and P. malariae. Destruction of erythrocytes leading to hemolysis, clinically manifests as fever with chills, splenomegaly and anemia. Amongst all these species, P. falciparum causes more severe disease and hence accounts for most of malarial deaths.

Examination of Peripheral Smear (PS) is the routinely advised investigation in patients presenting with fever and chills. Along with peripheral smear, complete hemogram is advised frequently by physicians. Hematological parameters including platelet counts, hemoglobin concentration and total leukocyte count frequently show variation in patients infected by P. vivax and P. falciparum. Although, exact pathophysiology of reduction in platelet count and increased mean platelet volume is not known, a few hypotheses including coagulation disturbances, splenomegaly, bone marrow alterations, antibody-mediated platelet destruction and oxidative stress have been postulated [3].

The present study was aimed to assess abnormal hematological parameters in peripheral smear proven malaria case.

MATERIAL AND METHODS

This is a retrospective study over a period of one year from

December 2011 to November 2012. A total number of 75 cases were included in the present study which was conducted at a tertiary care teaching centre. Sixty six cases of P. vivax and nine cases of P. falciparum were included. Patient's complete history and physical examination was performed. All the cases were confirmed to be caused by Plasmodium by demonstration of ring forms, trophozoites or gametocytes of the parasite by microscopic examination of the peripheral blood smear. Both thick and thin peripheral smears were examined with leishman's stain. Further, all cases were positive for malarial card test (Advantage mal card®) and Quantitative buffy coat test (BD Company®). Previous history of malaria, positive drug history and other causes of thrombocytopenia including dengue cases were excluded from the study.

Hematological parameters like hemoglobin concentration, total leukocyte count, platelet count and mean platelet volume were noted from fully automated 5 part cell counter- XT- 1800i Sysmex Analyser® and also were counted manually as per standard technique. Repeat platelet counts were done in subjects with severe thrombocytopenia until normal or near-normal values were reached.

Thrombocytopenia was defined as platelet count of less than 150 x 10^9/L. Further subgroup based on degree of reduction in platelet counts was done. Thrombocytopenia was considered severe if < 20 x 10^9/L, moderate if 20-100 x 10^9/L, and mild if 100-150 x 10^9/L.

RESULTS

Seventy five cases were studied in this case series over a period of 1 year. The patients age ranged from five to 61 years with mean age of 23 years. There were 70 males and five females in the study population. Thrombocytopenia was observed in seventy one of 75 cases. Sixty six (88%) were infected by P. vivax while 9 (12%) had P. falciparum infection. There were no cases of mixed infection in our study.

The most common presenting complaint was fever with chills. Only five cases had headache, nausea and myalgia. Fifty one (77.27%) cases of P.vivax infection showed moderate thrombocytopenia while it was found in 8 (88.88%) patient infected by P. falciparum [Table/Fig-1]. Severe thrombocytopenia was seen in one case of falciparum infection and four cases of vivax infection.

Nineteen cases (28.78%) of P. vivax had increased mean platelet volume >11.5 fL [Table/Fig-2]. Out of 66 cases infected by P. vivax 23(34.84%) had total leukocyte count less than 5000 cells/cumm, while 4 (44.44%) cases of P. falciparum from total of nine showed similar reduction [Table/Fig-3]. Further, severe anemia was also seen in vivax infected cases 25(37.87%) compared to 5 (55.55%) of cases infected by P. falciparum [Table/Fig-4].

Platelet count	Patients infected with P Vivax	Patients infected with P Falciparum
Normal count (150-440 x 10^9/L)	4(06.06%)	0
Mild Thrombocytopenia (100-150 x 10^9/L)	7(10.60%)	0
Moderate Thrombocytopenia (20-100 x 10^9/L)	51(77.27%)	8(88.88%)
Severe Thrombocytopenia (<20 x 10^9/L)	4(06.06%)	1(11.11%)
Total	66	9

[Table/Fig-1]: Thromobocytopenia in P. vivax and P. falciparum malaria

Mean platelet volume	No. of patients infected with P. vivax	No. of patients infected with P. falciparum
8-11.5fL	47 (71.21%)	7 (77.77%)
>11.5 fL	19 (28.78%)	2 (22.22%)

[Table/Fig-2]: Mean platelet volume

Total leukocyte count	No. of patients infected with P. Vivax	No. of patients infected with P. falciparum
5000-11000 cells/cumm	43(65.15%)	5(55.55%)
<5000 cells / cumm	23(34.84%)	4 (44.44%)
Total	66	9

[Table/Fig-3]: Total leukocyte count in malaria

Haemoglobin level	No. of patients infected with P. Vivax	No. of patients infected with P. falciparum
11.5-18 g/dl	41 (62.12%)	4(44.44%)
<11.5 g/dl	25(37.87%)	5(55.55%)
Total	66	9

[Table/Fig-4]: Hemoglobin level in malaria

DISCUSSION

In the present study we observed concurrent thrombocytopenia with anemia and leucopenia in peripheral smear proven malaria patients. Thrombocytopenia was seen in 71 (94.66%) of seventy five cases. Malaria presents with varying clinical features hence role of diagnostic modalities is of utmost importance. The reduction in the platelet count on a peripheral smear in

a case of fever is often a clue to the presence of malaria as seen in this study. Aarti et al., encountered similar findings of reduction in platelet count with resultant thrombocytopenia in 24 of 27 cases infected with P. Vivax infection in India [4].

A retrospective study by Chandra et al., in 334 cases of acute malaria in Uttarkhand state caused by P. vivax, P. falciparum and dual infection had thrombocytopenia with higher Mean Platelet Volume (MPV). The authors concluded that rise in MPV as more sensitive marker of P. vivax infection while Platelet Distribution Width (PDW) was found to be sensitive for P. falciparum infection. We observed similar increase in MPV in P. vivax infection [5]. In an another study by Chandra et al., an increased MPV was observed in malaria patients in which the pathogenesis of thrombocytopenia was due to increased peripheral destruction (hyperdestuctive) while decreased MPV was attributed to bone marrow disease as a result of hypoproductive state [6]. An increase in MPV was higher in vivax infected 19 cases (28.78%) in the present series.

The mechanism of resultant thrombocytopenia in malaria is explained by peripheral destruction of platelets resulting in consumption by Disseminated Intravascular Coagulation (DIC) [7]. Panasiuk et al., and Conte et al., found that Platelet-Associated IgG (PAIgG) is increased in malaria and is associated with thrombocytopenia [8,9].

Erel O et al., found oxidative stress as a cause for thrombocytopenia. They observed reduced platelet superoxide dismutase and glutathione peroxidase activities of the patients with vivax malaria while platelet lipid peroxidation levels were higher [10]. Engwerda CR et al., observed that, resultant splenomegaly in malaria due to phagocytosis of parasitised red blood cells as an immune response against parasites [11]. Marques suggested that activation of coagulation could be partially responsible for thrombocytopenia in falciparum and vivax patients by demonstrating a negative correlation between platelet counts, thrombin-anti-thrombin complex and D-dimers [12].

We observed anemia and leucopenia more commonly amongst the patients infected by P. falciparum. The major mechanisms of anemia in malaria are those of red cell destruction and decreased red cell production. The haemolysis leads to loss of infected cells by rupture or phagocytosis. While uninfected cells are removed by spleen from the circulation as a result of antibody sensitization or other physio-chemical membrane changes. The resultant anemia is further contributed by ineffective erythropoiesis due to dyserythropoiesis and marrow hypoplasia as seen in acute infections [13].

CONCLUSION

In the present study, malaria infection by P. vivax was more common than P. falciparum species. All the cases of P. falciparum showed thrombocytopenia. Thus thrombocytopenia, leukopenia and anemia were commonly observed hematological abnormalities noticed amongst the study population. A finding of thrombocytopenia and anemia in febrile patient should raise the suspicion of malaria; hence further specific tests can be employed for confirmation. When used in combination with clinical and microscopical examination, these parameters could improve the malaria diagnosis along with established methods.

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