Original Article

Hematological Parameters in Malaria and its Correlation with Parasite Index: A cross-sectional study in Pakistan

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Abstract

Objective: To determine the haematological parameters in malaria (Hb, TLC, Platelets) and correlate them with parasite index.

Methodology: This was a descriptive cross-sectional study conducted at the Fauji Foundation Hospital, Rawalpindi in the setting of the Pathology Department from March-September 2020. A total of 85 cases were included in the study. The sample size was calculated keeping confidence level=95%, SD= 0.35, absolute precision required= 4%. Non-probability consecutive sampling was used for data collection.

Results: The average age (years) of patients was 27.96+18.60. There were 213 (66.8%) male and106 (33.2%) female cases. Patients presented with average TLC and Hb levels as 5.92+2.22 and 11.22+1.68 respectively. Mean values of TLC among high and low parasite index (PI) were 6.14+1.67 and 5.83+2.41 respectively (p-value 0.564) whereas the mean values of Hb among high and low parasite index (PI) was 11.14+1.16 and 11.25+1.86 respectively (p-value 0.779). Mean platelet count among high and low parasite index (PI) was 27.44+90.81 and 61.20+31.09 respectively which was statistically significant (p-value 0.000).

Conclusion: Mild anaemia and moderate thrombocytopaenia were associated with high parasite index whereas no significant change was observed in TLC with high or low parasite index.

Keywords: Haematological parameters, Malaria, Parasite index, Pakistan.

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Introduction

Malaria is a mosquito-borne protozoal infection affecting an estimated 214 million people worldwide.[1] Pakistan has been categorized as one of the three countries of the WHO Eastern Mediterranean region that account for almost 95% of the total regional malaria burden.[2]

Plasmodium vivax, P. falciparum, P. ovale, P. malariae, and P. knowlesi are the different species of malaria. [3] Amongst them, P. vivax and P. falciparum (18%) are the two most prevalent Plasmodium species in Pakistan.[4] Microscopy is the gold standard diagnostic method. Other methods of diagnosing malaria include rapid detection of the parasite (antigen and enzyme) and molecular testing of genetic material. However, there are certain drawbacks of microscopy. In the case of a negative film, we need to examine at least three films during the onset of fever in the absence of antimalarial drugs to confirm the absence of the parasite in the blood by a trained person. Parasitaemia is the quantitative measure of the parasites per microliter (µL) of blood. Parasite index (PI) indicates the average parasitaemia in a given sample.[6] It is calculated by counting the number of infected red blood cells in relation to 1,000 red blood cells under a microscope [6]. It is one of the haematological indicators of the poor prognosis of severe malaria. It is useful in measuring the severity, treatment response, and prognosis, as hyperparasitaemia leads to high mortality.[7] Changes in haematological parameters like haemoglobin, total leucocytes and platelets counts are the hallmark of malarial infection. The most common haematological changes in malaria are thrombocytopaenia, anaemia and leucopaenia/ leukocytosis.[3,7] The cause of these changes is multi-factorial. Various studies have shown that there is a correlation between changes in blood counts in malaria with parasite index. The importance of knowing the correlation of the hematological findings with the parasite index is to assess the disease severity that would determine the management plan.

Methodology

This was a descriptive cross-sectional study performed at the Fauji Foundation Hospital, Rawalpindi from March-

September 2020. A total of 85 cases were included in the study with the following details of WHO sample size calculations; confidence level=95% mean TLC in malaria patients=5.917; population SD= 0.35, absolute precision required= 10%. Non-probability consecutive sampling was used for data collection. Inclusion criteria was to include all malaria positive patients detected by microscopy or ICT of all ages and both genders. All negative cases of malaria were exclude from the study design. About 2 ml of blood was drawn into EDTA tube from sterile syringes. All the full blood counts were performed along with thin-film microscopy within 3 hours of sample collection and analyzed on an automated Haematology analyzer (SYSMEX XN-1000). Full blood counts of all the malaria positive patients were performed. Thin-film was made by using a Leishman stain. Parasite species and parasite index was determined. PI was given by counting the number of parasites per 1,000 red blood cells on peripheral smear under a microscope. A count of 100,000 parasites/microliter corresponds to 2 % parasitaemia. A count of more than 100,000 parasites/microliter was taken as more than 2% PI.[8] The degree of parasitaemia, that is parasitic index was graded as less than 2% and more than 2%. The relation with Plt, Hb and TLC was measured. Data were entered and analyzed using the SPSS 21.0 version. Frequency and percentages were calculated for qualitative variables like gender, low and high PI. Mean and standard deviations of the quantitative variables like TLC, Hb, Plt and age was calculated. Association of blood counts like TLC, Hb, Plt with the PI (increased and decreased) was measured by applying an independent sample t-test. A p-value of <0.05 was considered as statistically significant.

Results

A total of 85 cases were included in the study. Out of 85 cases, only 2 were of P. falciparum [2%] and the rest were of P.vivax [98%]. The average age (years) of patients was 27.96+18.60. There was a male majority of patients with 57 (67.1%) while females were 28 (32.9%). Patients presented with average TLC and Hb levels as 5.92+2.22×109/L and 11.22+1.68 g/dL respectively. The average platelet count was 80.68+62.90×109/L as shown in Table I.

Table. II shows the comparison of the mean (TLC, Hb, Plt) in malaria based on Parasite index (high and low). Mean values of TLC among high and low parasite index (PI) were 6.18+1.67 ×109/L and 5.79+2.41 ×109/L respectively (p-value 0.167) whereas mean values of Hb (g/dL) among high and low parasite index (PI) was 11.14+1.15 and 11.28+1.86 respectively (p-value 0.506) whereas the mean platelet count among high and low parasite index (PI) was 129.36+92.05 ×109/L and 60.65+30.94 respectively which was statistically significant (p-value 0.000).

Table I: Mean of haematological parameters	
Parameters	Mean$\pm$SD
TLC($\times 10^3/\mu$L)	5.92$\pm$2.22
Hb(g/dL)	11.22$\pm$1.68
Plt($\times 10^3/\mu$L)	80.68$\pm$62.90

Table II: Haematological parameters in relation to parasite index					
	Parasite Index (PI)	n	Mean	Std. Deviation	p-value
WBC	PI $\leq$ 2%	92	6.14	1.67	0.167
	PI > 2%	227	5.83	2.41	
Hb	PI $\leq$ 2%	92	11.14	1.16	0.506
	PI > 2%	227	11.25	1.86	
Plt	PI $\leq$ 2%	92	127.44	90.81	0.000*
	PI > 2%	227	61.20	31.09	

Discussion

Although various studies have been conducted around the globe on haematological parameters there is a paucity of data on their correlation with parasite index. In this study, we evaluated the haematological parameters including Hb, platelet count, and TLC in patients infected with malaria and their correlation with parasite index. Pakistan has a higher prevalence of plasmodium vivax (71.8%) than Plasmodium falciparum (28.8%).[8] A much higher prevalence of P.Vivax was also seen in our study (98%). This is similar to a study by Jadhav et al., in India 8 and a study by Agha Khan University, Pakistan where the prevalence of P.vivax was 83%. Our study showed a higher trend of malaria in males (66.8%) as compared to females (33.2%). A study from Swat, Pakistan also showed a higher trend of malaria in the male gender (62.12%), and the possible cause was found to be the difference in the environmental exposure related to work.[9] The mean age of the patients in our study was 27.96+18.60 years. Rehman et al., investigated the

prevalence of malaria in different age groups and it was found that 51% of patients were in the age group of 21-40 years and 33.68% were of the age 1-20 years.[10]

Majority of the patients (60%) in our study had a parasite index of >2%. A study in India by Dutta found > 5% parasite index in 30% of malaria positive cases while in Yemen a study by Shalehay et al., reported a parasite index of >5% in only 19% of cases.[11] Other parameters such as the haematological indices have the ability to help as an adjunct tool in strengthening the suspicion of malaria leading to a meticulous search for malaria diagnosis. The most frequently affected parameters in malaria are Hb and Plt.[12] Mean plt count in our study was 80.68+62.90×10⁹/L. According to the literature review, the possibility of malaria rises 12-15 times with fall in platelet count <150×10⁹/L.[12] A study in Indonesia showed mild to moderate thrombocytopaenia (50-100 ×10⁹/L) in 45.5% of the malaria positive patients.[13] A study in East Kalimantan found that the prevalence of thrombocytopaenia was 85% with 45.6% showing moderate thrombocytopaenia (50-100×10⁹/L)[14] In our study, the mean haemoglobin was 11.24+1.68 g/dL while Faseela et al., [15] reports anaemia in only 18% of malaria cases and Inam Ullah et al.,[16] reported anaemia in 77% of patients with a mean value of 10.7 ± 2.36 g/dL.

However, in our study, mean Hb was 11.28+1.85/dL in patients with a parasite index of >2%. A study in Africa showed that 76.9% of children presenting with malaria had anaemia. Out of 76.9% of the infected individuals, moderate anaemia (Hb 10-12g/dL) was seen in 56% of children. [17] TLC is the least affected parameter in malaria. In a study by Jhadhav et al., 14% of malaria patients had leucopaenia with only 4.9% having leukocytosis. [18] In our study, no significant change in TLC was seen with a mean TLC of 5.90+2.23×10⁹.

Conclusions

We conclude that mild anaemia and moderate thrombocytopaenia are associated with high parasite index whereas no significant change is observed in TLC irrespective of high or low parasite index.

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