SHORT REPORT

Haematological outcomes in progression of malaria: A cohort study from district Dera Ismail Khan, Pakistan

Zahid Ullah,[1] Aamer Ali Khattak,[2] Nighat Aziz,[3] Hassan Khan,[4] Rahila Bano,[5] Usman Ayub Awan[6]

Abstract

Malaria is the second highest reported disease from public health sector which affects about 4 million people each year in Pakistan. The study sought to evaluate the haematological changes in malarial patients in order to find any relation of these changes with malarial pathogenesis.

This cross sectional descriptive study was designed at the pathology department of Gomal Medical College, Dera Ismail Khan during March 2015 to February 2017. Blood samples were collected from 400 malaria microscopy positive in EDTA tubes for the analysis of haematological parameters like Total leucocyte count, Haemoglobin, Platelets, Mean Cell Volume, Mean Cell Haemoglobin and Mean Cell Haemoglobin Concentration.

Out of the 400 cases of malaria, 366 (91.5%) were Plasmodium vivax, 24 (6.0%) were Plasmodium falciparum and 10 (2.5%) were co-infection of Plasmodium vivax and Plasmodium falciparum infection. Anaemia was seen in 148 (37%) of cases; thrombocytopenia was 316(79%) and 60 (15%) cases had leucopenia.

This study shows that malarial patients exhibited important changes in haematological parameters like thrombocytopenia; anaemia and leucopenia are significant predictors of malaria infection. When used in combination with other clinical and microscopy methods, these parameters could improve the diagnosis and treatment of malaria.

Keywords: Haematological Parameters, Plasmodium vivax, Plasmodium falciparum, Dera Ismail Khan, Pakistan.

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Introduction

Malaria is ranked high among group of diseases with drastic health problems worldwide. According to figures from World Health Organization (WHO) in 2011, prevalence was 26 million with mortality rate of 0.1 million. Geographical surveys revealed more than 100 countries and their territories are under malarial endemicity thus making 3.3 billion people at risk.[1] Khattak et al., from Pakistan in 2013, reported 60% people living in endemic areas of Pakistan.[2] Four main species of Plasmodium (P. falciparum, P. vivax, P. ovale and P. malariae) cause malaria, of which P. falciparum and P. vivax are most prevalent across Pakistan.[3,4]

In the past several decades, great advancement has taken place in the field of biological sciences which revealed complex life cycle of malaria in human body. Continuous multiplication of Plasmodium in blood stream initiates the rapid destruction of erythrocytes, endothelial activation and microvascular inflammation triggering the drastic effects in various organs. Moreover, overwhelming outcomes also include several alterations in haematological entities.[5] Haematological pattern among malaria infected patients presented with remarkable thrombocytopenia, anaemia and leucopenia while neutrophils and monocytes counts were significantly increased.[6,7]

Typically, peripheral blood smear is most widely used test and is termed as gold standard technique for the detection of malarial parasite. Secondly, the most widely accepted method for molecular diagnosis is PCR.[8] Hence; the goal of timely diagnosis is difficult to achieve. Scanty literature is available to investigate the clinical significance of haematological parameters in malarial patients from Pakistan.

Dera Ismail Khan (D.I.Khan) is district from southern Khyber Pakhtunkhwa province, Pakistan. Total population is 1.6 million, with annual burden of malaria reported as 20% in the year 2006.[9] Therefore, this study was conducted with intention of observing the correlation of different haematological parameters with malarial patients from D.I. Khan and improve its utilization in clinical settings.

Methods and Results

[1,5]Department of Pathology, [3]Department of Pharmacology, Gomal Medical College, Dera Ismail Khan, KPK, [2,6]Department of Medical Lab Technology, University of Haripur, Haripur, KPK. [4]Department of Pharmacy, Gomal University, Dera Ismail Khan, KPK. Pakistan.
Correspondence: Zahid Ullah. Email: zahidwazir150@hotmail.com

Table-1: Overall plasmodium species (n=400).

P. vivax	P. falciparum	Mixed (P. vivax & falciparum)	P. malariae	P. ovale
366 (91.5 %)	24 (6.0 %)	10 (2.5 %)	00	00

Table-2: Mean and standard deviation of various hematological parameters.

Hematological Parameters	Reference Range	P. vivax Mean ± SD	P. falciparum Mean ± SD	Mixed (P. vivax &falciparum) Mean ± SD	P. value
Hb (g/dL)	12 - 16	11.2 ± 2.3	9.5 ± 1.8	10.1 ± 1.2	<0.001
TLC ($\times 10^9$/L)	4.0-10.0	6.8 ± 2.8	6.1 ± 2.2	7.2 ± 1.7	0.01
PLT($\times 10^9$/L)	150 - 450	110 ± 55	88 ± 45	102 ± 51	<0.001
MCV (fl)	80-98	84.8 ± 6.2	83.6 ± 7.2	85.9 ± 7.2	0.01
MCH (pg)	27-32	25.6 ± 3.0	24.1 ± 2.8	24.9 ± 2.9	<0.001
MCHC(g/dL)	31.5-36.0	29.3 ± 1.8	28.9 ± 1.3	28.8 ± 1.2	<0.001

Hb: Hemoglobin, TLC: Total Leucocytes Count, PLT: Platelets, MCV: Mean cell volume, MCH: Mean cell hemoglobin, MCHC: Mean cell hemoglobin concentration.

This cross sectional descriptive study was designed at Pathology department of Gomal Medical College district Dera Ismail Khan and conducted at private health center between March 2015 and December 2017 with approval of Gomal Medical College ethical committee. About 2 ml of anticoagulated whole blood was collected for Giemsa stained thick and thin blood film for malarial microscopy. Malaria positive samples were analyzed for haematological parameters (Total leucocytes count (TLC), platelets count, haemoglobin (Hb), Mean cell volume (MCV), Mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC)) using automated haematology analyser Rayto (RT-7600). Sample size was calculated by a Web-based Epidemiologic and Statistical Calculator Open Epi.[10] For Data analysis SPSS version 19 was used. Categorical variables were compared by using Chi-square test, to compare the quantitative variables a t-test was used and p value $\leq$ 0.05 was considered statistically significant.

Out of 400 malaria positive cases 268 (67%) were males and 132 (33%) females with median age of 24.5 years. P. vivax infection was found in 366 (91.5 %), 24 (6.0 %) for P. falciparum, 10 (2.5 %) were mixed for both P. Vivax and falciparum and no case of P. malariae and P. ovale was detected (Table-1).

Mean ± Standard Deviation of haematological parameters Plasmodium species infection is represented in Table-2.

Figure-1: shows the Percentage of anaemia, thrombocytopenia and Leucopenia.

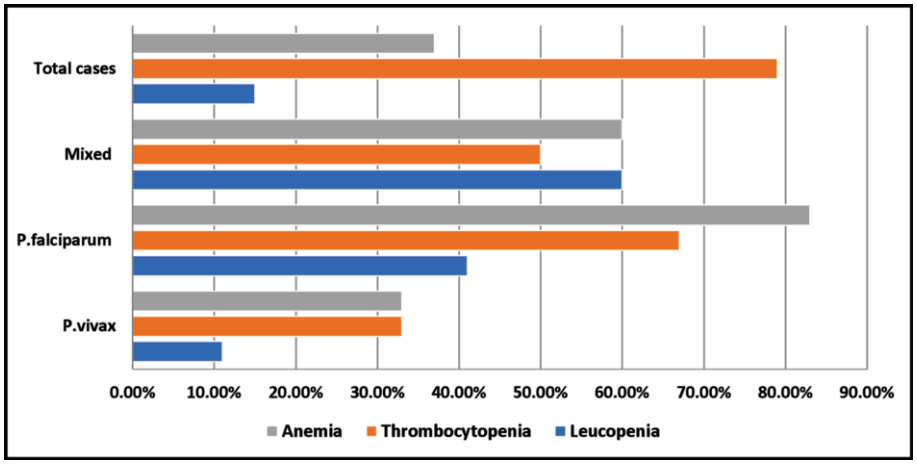

Figure-1: Percentage of anemia, thrombocytopenia and Leucopenia.

Discussion

Malaria is one of the most common vector born infectious diseases and continues to be a severe public health problem in Pakistan. Almost all severe forms and deaths from malaria are caused by P. falciparum. Rarely, by other malarial species.[3,11] Mortality is predominantly occurring due to severe anaemia or cerebral malaria in P. falciparum infections.[12] In this study a total of 400 malaria confirmed microscopy cases were evaluated for various

Haematological parameters in which 91.5% were P. vivax, 6.0% were P. falciparum and 2.5% were mixed infection and not a single case of P. malariae and P. ovale was noted. Many studies have been conducted in Pakistan and they report that P. vivax and P. falciparum are the two-predominant species with no evidence of P. malariae and P. ovale and our results are in line with past observations.[13,14]

After the transmission of plasmodium by anopheles mosquito, the parasite invades the liver and gives rise to shivering, pyrexia and rapid destruction of erythrocytes which results in anaemia. Anaemia is the major clinical manifestation of malaria, which then becomes life threating especially in children and pregnant women.[15] Pathogenesis of anaemia during malaria is extremely complex, though it to be thought that Plasmodium primarily causes lysis of erythrocytes, haemolysis and removal of both parasitized and non-parasitized erythrocytes. Bone Marrow suppression and splenic sequestration which decrease the amount of RBCs.[12]

In this study anaemia is one of the common laboratory finding in P. falciparum (83%) as compared to P. vivax (32%). Many studies have reported the occurrence of anaemia in P. falciparum malaria. Our findings are consistent with previous reports.[16,17] The possible reason is that P. falciparum can attack erythrocytes of all ages. Similarly, in P. falciparum there is marked destruction of both parasitized and non-parasitized erythrocytes, while P. vivax only infects young erythrocytes or reticulocytes.[18] This present study reports that RBCs indices MCH, MCHC both were decreased but MCV not affected. This finding is consistent with past reports.[19,20]

In our study thrombocytopenia was frequently present in both P. vivax and P. falciparum, the overall rate of thrombocytopenia was (79%). Many studies have been carried out around the globe and they reported that thrombocytopenia frequently occurs in malaria and our finding is in line with previous observations.[16,21] The mechanism behind thrombocytopenia in malaria is due to coagulation disruption, splenic sequestration, excessive removal of platelets by macrophages, bone marrow changes, antibody-mediated platelet destruction, oxidative stress and aggregation of platelets.[12]

In line with many studies, leucopenia was less frequently seen in the malaria-infected patients as in this study.[22-24] Leucopenia is suggesting the localization of leucocytes away from the circulation and to the spleen or to peripheral pools, rather than their actual reduction. Leucopenia with relative increase in large mononuclear cells is another indicator among various haematological parameters. Current study provides the detail insights to screen malarial patients presenting with febrile illnesses. Moreover, it also express the prevalence of malaria among one of endemic area of Pakistan. Talking about limitations, foremost one is unavailability of previous medical history regarding any haematological disorders, bacteria or viral infections which could affect the interpretation of results.

Conclusion

In the current study we observed that P. vivax as well as P. falciparum can cause significant changes in haematological parameters. Thrombocytopenia and anaemia were more common in P. falciparum as compared to P. vivax while mild to moderate level of leucopenia was also observed. From our study it is suggested that haematological parameters can be used as supporting, additional and helpful markers in malaria to avoid needless treatment, because it is easily accessible in routine clinical sittings.

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Conflict of Interest: None to declare.

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