Vol. VII, No. II (Fall 2022) Pages: 1 – 5 ISSN (Print): 2788-5569 ISSN (Online): 2788-5445

GPSR Global Pharmaceutical Sciences Review

Impact of Malarial Infection on Hematological Parameters in Patients at Tertiary Care Hospitals in D.I. Khan

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Abstract: *Malaria is among the leading parasitic infections in world causing major health problems. Plasmodium, being a blood parasite, causes changes in blood parameters. This study was aimed at identifying the Plasmodium specie and measuring the changes that occurred in hematological parameters, in malaria patients. The sample size consisted of 109 individuals divided into two (Infected and Control) groups: 71 malaria-positive and 38 malaria-negative individuals. The diagnosis was based on staining and direct visualization of the parasite under a microscope. Blood CP was performed on the "Sysmex XP 300 analyzer". Non-normally distributed continuous variables were compared using the Mann-Whitney U test. An association between malaria and thrombocytopenia and anemia was noted but severe cases were not observed. Female patients were more Anaemic and the reduction in leukocyte count was also observed among malaria patients. Malaria causes changes in hematological parameters with thrombocytopenia during malarial infection. However, anemia was observed in female patients.*

Key Words: DI Khan, Hematological Profile, Malaria, Patients

Introduction

Malaria is among the world's most important parasitic infections which pose major health challenges. In tropical regions all throughout the world, malaria is one of the leading causes of death. In 2010, it was reported that there were 219 million cases of malaria in the world (Ghanchi et al., 2019). The occurrence of variations in blood cell lines is a notable feature attributed to malarial infections. These variations occur in blood cell counts involving Red Blood Bells (RBCs), White Blood Cells (WBCs), and Platelets (PLT) (Kotepui et al., 2015).

Plasmodium species are responsible for malarial infection in humans. Many species of *Plasmodium* parasites co-exist, in different combinations, in malaria-endemic regions. Malaria caused by *Plasmodium falciparum* has the highest mortality rate and thus all the research efforts are focused on it whereas *Plasmodium vivax* had been responsible for the highest morbidity due to malaria, worldwide (McKenzie et al., 2005).

Plasmodium spp. is a systemic parasite and hence is expected to produce variations in blood parameters however some hematological changes related to malaria are well recognized whereas contradicting reports exist on other hematological changes (Igbeneghu & Odaibo, 2013). This study was aimed at the identification of the *Plasmodium* specie responsible for malaria and the determination of changes induced in hematological parameters in malaria patients in this region.

Material and Methods

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URL: http://dx.doi.org/10.31703/gpsr.2022(VII-II).01 **DOI:** 10.31703/gpsr.2022(VII-II).01

Citation: Ahmad, S., Amir, M., Shahbaz, M., Nazir, S., & Islam, S. (2022). Impact of Malarial Infection on Hematological Parameters in Patients at Tertiary Care Hospitals in D.I. Khan. *Global Pharmaceutical Sciences Review*, *VII*(II), 1-5. https://doi.org/10.31703/gpsr.2022(VII-II).01

The data used in this study belong to two tertiary care hospitals of district Dera Ismail Khan, province KPK of Pakistan. The sample size consisted of 109 persons divided into two groups: 71 malaria-positive patients comprising 26 females, 30 males and 15 children were taken as the infected group and 38 malaria-negative individuals comprising six children, 23 females, and nine males were taken as a control group. The infected group of individuals were diagnosed with acute malaria and received health facilities at tertiary care units. Acute malaria was diagnosed by the on-duty physician defined as a history of fever in the past 72 hours with the presence of parasitemia. Informed consent of patients or their guardians, in the case of children, was obtained.

Utilizing light microscopy to evaluate thick and thin stained blood smears is still the gold standard for diagnosing malaria. Microscopical studies based on staining and direct microscopic observation of the parasite made up the laboratory investigations. The Blood Complete Picture (CP) test was performed using the "Sysmex XP 300 analyzer." This analyzer is a quantitative, automated haematology analyzer used in clinical laboratories to evaluate patient populations for in-vitro diagnostics.

The Mann Whitney U test, a non-parametric variation of the t-test, was used to analyze the continuous haematological parameter values because they did not follow a normal distribution. Using IBM SPSS Version 20, the data were analyzed, and a P value of less than 0.001 was considered to be very significant.

Results

Among 71 malaria-positive individuals, seven cases were reported as *P. falciparum* whereas 64 were *P. vivax*. Hematological parameters of females of both groups, males of both groups, children (<12 years) of both groups, and males and females of the infected group, were compared. Moreover, a comparison between cases of *P. falciparum* and *P. vivax* was also done.

Comparison of hematological parameters of females of infected and control groups revealed a strong significant differences in PLT count and Hb level. PLT count and Hb level were decreased in malaria patients as equated to the control group. WBC count was moderately significant whereas RBC count was not found significant (table 1).

Table 1. Analogy of Hematological Parameters amongst Females of Infected and Control Groups

Parameters	Infected (Mean rank)	Control (Mean rank)	P value
WBC	18.46	32.39	0.001
RBC	23.52	26.67	0.440
Hb	16.08	35.09	<0.001
PLT	16.31	34.83	<0.001

Statistical comparison between males of infected and control groups revealed a strong significant difference in PLT count. WBC count was moderately significant and RBC count was weakly significant whereas Hb level remained unaffected by malaria infection in males. Reduction in thrombocyte count was a pronounced feature in males during malaria infection (table 2).

Table 2. Analogy of Hematological Parameters amongst Males of Infected and Control Groups

Parameters	Infected (Mean rank)	Control (Mean rank)	P value
WBC	17.75	32.56	0.001
RBC	22.69	15.00	0.092
Hb	21.30	19.94	0.769
PLT	17.28	34.22	<0.001

In children, all the parameters i.e WBC count, Hb level, and PLT count except RBC count showed a weak significant difference between the two groups whereas RBC count remained unaffected in children

(table 3).

Table 3. Analogy of Hematological Parameters amongst Children of Infected and Control Groups

Parameters	Infected (Mean rank)	Control (Mean rank)	P value
WBC	8.39	16.17	0.014
RBC	10.50	12.25	0.569
Hb	9.53	14.67	0.095
PLT	9.13	15.67	0.029

On comparison between cases of *P. vivax* to *P. falciparum*, PLT count, and WBC count were moderately significant whereas Hb and RBC count were not appreciably different amongst both groups (table 4).

Table 4. Analogy of Hematological Parameters in cases of *P. vivax* vs. *P. Falciparum*

Parameters	*P. vivax* (Mean rank)	*P. falciparum* (Mean rank)	P value
WBC	35.20	51.63	0.039
RBC	37.59	32.19	0.469
Hb	37.60	32.13	0.491
PLT	34.85	54.44	0.014

The infected male-to-female comparison showed that Hb level was strongly significant between the two groups RBC count was moderately significant however WBC count and PLT count were not different (table 5).

Table 5. Analogy of Hematological Parameters amongst males and Females of the infected group

Parameters	Female (Mean Rank)	Male (Mean Rank)	P value
WBC	30.58	28.63	0.661
RBC	22.69	35.03	0.006
Hb	19.40	37.70	<0.001
PLT	30.13	28.84	0.743

Discussion

Hematological changes are considered indications of malaria (Abro et al., 2008). However, changes in some blood parameters have been associated with malaria while there are conflicting reports about other parameters (Igbeneghu & Odaibo, 2013). Some studies have been conducted around Pakistan to analyze and co-relate systemic changes with malaria however, any such study is lacking in this current area of study. This study was aimed at determining and comparing changes caused by a malarial parasite in hematological parameters.

The findings of this study showed that PLT count, among all three groups; female, male, and children, was significantly different from that of control group members. In previous studies, thrombocytopenia had also been observed commonly in malaria patients in the lab, yet the precise etiology is also not well stated (Ghanchi et al., 2019). It is thought to occur through peripheral destruction and extensive exclusion of the platelets by splenic amalgamating and platelet usage because of Disseminated Intravascular Coagulation (DIC) (Maina et al., 2010). Thrombocytopenia in malaria had been assumed to occur as immune-mediated destruction of circulating platelets and platelets being postulated to arbitrate clopping of *P. falciparum* infected erythrocytes (Pain et al., 2001). Many small platelets are clumped, probably because of cytokine interference of megakaryopoiesis, in groups of (3-12) platelets and are deceptively totaled as only platelet by the analyzers, leading to pseudo-thrombocytopenia (Maina et al., 2010). The findings of our study support the above-stated inference that low PLT count in malaria might be due to platelet

destruction and/or also pseudo thrombocytopenia. Malarial infection is thought to increase the likelihood of platelet aggregation, in addition, amplified C reactive protein (CRP), known as a pointer of tenderness also, is linked with malaria and considered responsible for the clumping of platelets in malaria (Maina et al., 2010). Our study is in line with these preceding studies in finding reduced PLT count as the most pronounced feature of malarial infection however, severe cases of thrombocytopenia had not been observed.

There was a subtle reduction in the WBC count of patients as equated to those of control group members. There exist conflicting reports on WBC count in malaria patients, some studies demonstrated leukopenia or leukocytosis whereas others described no momentous variance in WBC count between infected and control groups (Maina et al., 2010). Our study noticed a trivial decline in WBC sum in malaria patients when compared with the control group. Reduced leucocyte count in our study agrees with findings of previous studies stating leukopenia in malaria perhaps occur in the non-immune and semi-immune population, (Kassa et al., 2005) whereas leukopenia had been associated with mild malaria, yet leukocytosis occurs in severe malarial infection (McKenzie et al., 2015)

Anemia in malaria is one of the frequently occurring complications in malaria-endemic areas and pregnant women and younger children are more affected by it (Menendez et al., 2000). In this study, female patients were majorly found anemic and their Hb level was significantly different from their male counterparts. This could be probably because many Pakistani people suffer from anemia among which the majority are females and the prevalent type of anemia among them is particularly iron deficit anemia affecting all age groups, from children to adults (Akhtar et al., 2013). A previous study in Nigeria stated that hemoglobin level appears to be highly impacted by malaria in regions of prevailing anemia and poor nutrition status (Igbeneghu & Odaibo, 2013). Other than nutritional status, anemia in malaria had also been thought to be due to the destruction of infected as well as clean RBCs, a decrease in erythrocyte precursors, and inhibition of erythropoiesis ultimately leading to unembellished malaria or demise, particularly in *P. falciparum* cases (Coronado et al., 2014). In addition to poor health conditions prevailing in this area, the causation of anemia due to malaria should also be considered as mentioned in another study that anemia in malaria can be measured as the aggregate influence of malarial infection on a specific patient. Patients displaying a protracted history of illness were more likely to develop anemia and a 3-fold lessening was observed in their hematocrit count (Prince et al., 2010).

The inadequacy of this study was the small sample size comprising the limited number of patients reported over a small-time span. A small sample size of children and *P. falciparum* cases was the limitation in formulating a strong conclusion among these two groups.

Conclusion

In conclusion, reduced PLT count, and anemia remained the two most significant changes caused by malaria. Anemia was more evident among the female population which can be due to prevailing poor health conditions in this region. Reduction in PLT count seemed to occur due to platelet destruction and/or platelet clumping known as pseudo thrombocytopenia. Anemia and thrombocytopenia can serve as hallmarks of malarial infection though further study with a large sample size would be needed.

Acknowledgments

The authors declared no competing interests. This study was not funded by any authority. The data in this study belong to two tertiary care hospitals, District Headquarter Teaching Hospital and Mufti Mahmood Teaching Hospital, of district Dera Ismail Khan, province Kpk Pakistan.

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