Association of Hematological Parameters with Malaria Positive Patients in District Bannu

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ABSTRACT

Background: Malaria is one of the most widespread parasitic blood infections caused by plasmodium parasite. Well known feature of malaria is change in hematological parameters such as red blood cell, hemoglobin, platelets, white blood cell and differential count are significantly low. This study aim was to find the association of malaria with Complete Blood Count in malaria positive patient.

Methods: A six-month cross-sectional research was carried out in the Bannu district. Venous blood samples from 500 individuals were taken and placed in EDTA tubes for smear preparation and total blood counts. The Sysmex Hematology Analyzer was used to evaluate blood counts. Using SPSS-22, all data were calculated.

Results: Among total, 60 Malaria positive patient samples were processed for association of malaria with CBC. Out of total, male were 78% and female were 22%. Malaria positive patient with anaemia were found 53% in which male and female were 81% and 18% respectively. Thrombocytopenia were found in 16% in which male were 60% and 40% female patients. Malaria positive with abnormal TLC were observed in 11% patients (male 8%, female 3%). Moreover, Malaria positive with abnormal DLC were found 70% (male 73%, female 26%).

Conclusion: This study shows a significant change in hematological parameter in Malaria patients. Thrombocytopenia is second most common hematological abnormality. In TLC abnormality, rare cases of leukocytosis were noted. In malaria-endemic regions, hematological indicators may be a suitable and reliable adjuvant in the early identification of individuals with mild-to-severe parasitemia.

Keywords: Malaria, Anemia, Total leukocyte count, Differential leukocyte count, Platelets.

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INTRODUCTION

The most common parasite-borne illness in the world is malaria. The parasites that cause malaria are called Plasmodial species.[1] *Plasmodium falciparum* is responsible for the vast majority of cases and nearly all fatalities. Less severe forms of malaria are caused by *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae*.[2] Severe malaria can cause serious complications that can develop quickly and lead to death in a matter of hours or days. These include bleeding, severe anemia, acute renal failure, cerebral malaria, and/or pulmonary edema.[3] Usually starting 8–25 days after infection, malaria signs and symptoms appear. All malaria species have initial symptoms that are comparable to flu-like symptoms and can be mistaken for other illnesses such viral infections, sepsis, and gastroenteritis. Headache, fever, shivering, joint pain, vomiting, hemolytic anemia, jaundice, haemoglobin in the urine, retinal impairment, and convulsions are possible presenting symptoms.[4, 5]

Malaria poses a threat to about half of the world's population, who reside in around 100 nations and territories.[6] According to World Health Organization (WHO) data from 2018, there were an estimated 228 million cases of malaria globally, with 93% of those cases occurring in the WHO Africa Region.[7] According to research, children under the age of five were more likely than older children and adults to contract severe malaria, an illness linked to major organ damage in malaria-endemic nations. This has a significant impact on the growth of local children.[8]

Approximately, 60% of Pakistan's 161 million inhabitants, or 95 million people, reside in areas where malaria is prevalent.[9] The recent floods that impacted more than 60 districts and almost 20 million people can be partly blamed for the rise in malaria cases.[10] In Pakistan, there are 500,000 cases of malaria infection and 50,000 fatalities related to the disease annually, despite effective malaria control measures.[11, 12]

The range of prevalence for *P. falciparum* was 0.1% in Islamabad to 3.8% in Baluchistan, whereas the range for *P. vivax* was 2.4% in Punjab Province to 10.8% in Sindh Province.[13] Between Orakzai Agency and North Waziristan Agency, the frequency of *P. vivax* varied from 10.4% to 22.8%. Khyber Agency reported the greatest incidence of mixed species (1.7%), with *P. falciparum* ranging in prevalence from 1.3% in Orakzai Agency to 4.7% in North Waziristan.[14] Malaria in FATA is mostly caused by *P. vivax* and *P. falciparum*, however infections with mixed species are also common and have different transmission intensities.[14] Estimates of malaria incidence also demonstrate a significant degree of heterogeneity in the incidence, frequency, and species composition of malarial parasites. In most parts of Pakistan, including Khyber Pakhtunkhwa, Baluchistan, and the Sind provinces, the epidemiology of malaria is often seasonal.[15] According to Qureshi *et al.,* (2020), there is a significant transmission of malaria in September, November, and throughout the monsoon season, but not as much in the spring, particularly in March and April.[15, 16]

For uncomplicated malaria, artemisinin-based combination treatments (ACTs) are now the recommended course of therapy.[17] In these treatments, an antimalarial or antimalarials of a different class are combined with artemisinin or one of its derivatives. Currently, artemether-lumefantrine, artesunate-amodiaquine, artesunate-mefloquine, artesunat, and sulfadoxine/ pyrimethamine are advised medications for ACT.[18]

The easiest sample for diagnosis to get is blood. Hematological alterations are among the most frequent malarial consequences, and they are crucial to the disease's pathogenesis. Red blood cells, leukocytes, and thrombocytes are among the main blood components affected by these alterations.[19] For non-immune youngsters in particular, timely and correct diagnosis is essential to efficient illness care and a positive prognosis in cases of malaria infection.[20]

Hematological alterations are among the most prevalent malarial consequences, and they are crucial to the disease's etiology.[21] The primary cell types, RBCs, leukocytes, and thrombocytes are affected by these alterations. In contrast to non-malaria infected individuals, patients with malaria tended to have considerably lower levels of platelets, WBCs, lymphocytes, eosinophils, RBCs, and Hb, but their counts of monocytes and neutrophils were significantly greater.[22]

Individuals with malaria often had considerably reduced levels of platelets, white blood cells, lymphocytes, eosinophils, red blood cells, and hemoglobin; in contrast, the counts of monocytes and neutrophils were much greater than those of individuals without malaria.[23] Thrombocytopenia is a frequent consequence of malaria infection.

Individuals with platelet counts less than 150,000/µl had a 12–15 times higher risk of contracting malaria compared to those with counts greater than 150,000/µl.[24] Malaria trophozoites breakdown hemoglobin, which promotes parasite growth and asexual reproduction while accumulating toxic heme, which is the mechanism behind anemia in malaria patients.[25] This Study aims was to study the complete blood count level in malaria positive patients in district Bannu, Khyber Pakhtunkhwa, Pakistan.

MATERIALS AND METHODS

At the Khalifa Gul Nawaz Teaching Hospital and the District Head Quarter Hospital in Bannu, Khyber Pakhtunkhwa, Pakistan, a six-month descriptive cross-sectional research was conducted from June 2023 to November 2023. All patients suspected of having malaria were included in this study, regardless of age, gender, or ethnicity. The study involved the recruitment of 500 patients in total. Exclusions from the research included those with leukemia, chronic liver illnesses, blood cancer, and other serious conditions. Furthermore, this study did not includes neonates, or uncooperative individuals. The study received ethical approval from both of Bannu's tertiary care facilities. Before the study is conducted, a consent form is collected from the patients or their guardian.

Patients' name, age, sex, place of residence, plasmodium type, signs and symptoms (fever, headache, chills, anemia), and hematological alterations were all noted along with their demographic information. Using a sterile syringe, 3 mL of whole blood was extracted from each patient after the puncture site was cleaned with methylated spirit. The anticoagulant tube containing ethylene diamine tetra-acetic acid (EDTA) was promptly filled with about 3 milliliters of blood sample. The Sysmex 21 Hematology Analyzer was used to determine the total blood count. A report on blood counts was also released. To create the microscopic slide, a few drops of EDTA blood were utilized. The blood film was stained using the Giemsa staining procedure in order to diagnose malaria parasites. Under a microscope, a slide was examined, and a positive or negative malaria parasite report was obtained.

All the recorded data were entered and further analyzed through SPSS-22 and data will be presented in tables.

RESULTS

Among total of 500 samples, sixty (n=60) malaria positive patient samples were processed for association of malaria with CBC, male were 47 (78%) and female were 13 (22%). Malaria positive patient with anemia (low Hb) were total 53% (n=32) in which male were 81% (26/32) and female were 18% (6/32). Malaria positive patient with thrombocytopenia (low platelets/thrombocytes) were total 10/60 (16%), among them male were 6/10 (60%) and 4/10 (40%) were female. Malaria positive patient with abnormal (high) TLC (total leukocyte count)

were total 7/60 (11%) in which male were 5/60 (8%) and female were 2/60 (3%). Malaria positive patient with abnormal DLC (lymphocyte, neutrophil, monocyte, eosinophil) were total 42/60 (70%) in which male 31/42 (73%) and female were 11/42 (26%). Patient with only neutrophil abnormality (low or high) were total 36/60 (60%), in which male were 27/36 (75%) female were 9/36 (25%) (Table 1).

Malaria positive Patient of age 1-14 years were total 10/60 (16%) and 7/10 were anemia. Three patients were thrombocytopenia. Overall complete blood count or its component abnormality including anemia, thrombocytopenia, and leucocytosis occurred in 2/10. Malaria positive patient with complete blood count of age 15 to 30 were total 35/30 (58%). Out of 35 patients, hematological changes occurred in 25 patients. Among total 25 patient, 5 patient were thrombocytopenia and approximately twenty patients have anemia (Hb low than normal), 8 patients were leucocytopenia. Overall complete blood count i.e. anemia, thrombocytopenia, and leucocytosis occurred in 10/35. Patient from 31-45 years were total 9/60 (15%), out of nine 6 patients were anemia. No patient of thrombocytopenia were found in age group 31-45 years. Malaria positive patient from age 46-60 years were total 6/60 (10%). Out of 6 four patients were seen with abnormal complete blood count (Table 2).

Table 1: Gender wise distribution of malaria positive patients, anemia, thrombocytopenia, TLC, and DLC

Gender	Frequency & Percentages % (n)
Malaria cases distribution	
Male	78% (47)
Female	22% (13)
Total	100% (60)
Anemia (low Hb)	
Male	43% (26)
Female	10% (6)
Thrombocytopenia	
Male	10% (6)
Female	6% (4)
Abnormal Total leukocytes Count	
Male	8% (5)
Female	3% (2)
Abnormal DLC	
Male	51% (31)
Female	18% (11)

Table 2: Age-wise distribution of total malaria positive patient, Anemia (low HB), Thrombocytopenia, TLC, and DLC

Age group in year	01-14 years % (n)	15-30 years % (n)	31-45 years % (n)	46-60 years % (n)
Malaria Positive patients	16% (10)	56% (34)	18% (11)	8% (05)
Anemia (low HB)	70% (7)	58% (20/34)	54% (6/11)	60% (3/5)
Thrombocytopenia	30% (3)	14% (5/34)	0% (0/11)	20% (1/5)
Abnormal TLC	50% (5)	64% (22/34)	27% (3/11)	40% (2/5)

DISCUSSION

Malaria is a major health problem, which are strongly linked with morbidity and mortality in the tropic's regions of Pakistan,[26] especially in district Bannu. The study was carried out at district Bannu. Almost 60 malaria positive patient were included. Present study shows that malaria is more prevalent in male than females, with ranges of 47/60 (78%) males and 13/60 (22%) females. The infection rates were more in patient of age 15-30 years compared to other age groups. This study suggests that specific hematological alterations may differ with age, sex, and other demographic characteristics, malaria severity, and immune response, even though it demonstrates that hematological abnormalities in malaria infection are prevalent. Low Hb levels were

discovered in the range of less than 7 gm/dl to 12 gm/dl. Thirty-two (53%) of the sixty patients had moderate to severe low hemoglobin. According to the study, compared to other age groups, the percentage of low Hb is higher in the group aged 1 to 14 years.[27] According to some research, the major target of the parasite is the red blood cell, which leads to the destruction of RBCs, an accelerated elimination of both parasitized and non-parasitized cells, bone marrow malfunction, and a high degree of parasitemia.[28, 29] According to this study, the Hb level was much lower. Malaria causes both qualitative and quantitative changes in platelet abnormalities.

In this study, individuals with malaria showed a substantial decrease in platelet counts. Thrombocytopenia was observed in 16% of individuals with malaria. These findings might suggest that thrombocytopenia is a sign of a Plasmodium infection. There has been prior research describing the relationship between malaria infection and platelet count. Anemia was also common in the majority of patients with thrombocytopenia.[30] Many theories have been proposed on the causes of thrombocytopenia in malaria infections, including increased spleen pooling and platelet consumption through the process of disseminated intravascular coagulopathy (DIC).[31, 32] Reduced thrombopoiesis, an improbable cause of thrombocytopenia in malaria, is impacted by an adequate or increased number of megakaryocytes in the bone marrow.[33] Thrombocytopenia associated with malaria infection has been suggested to be caused by immune-mediated elimination of circulating platelets.[34] Most researchers draw the conclusion from various studies that the majority of patients suffering from malaria have leukopenia in their hematological parameter.[35]

Presumptive clinical diagnosis appears to be a viable approach due to the lack of resources and skilled medical workers in many malaria-infested locations. Comparing and analyzing the variations between febrile patients with and without malaria infection, as well as evaluating a larger sample size, would be intriguing. A longer-term research project with a more extensive participant cohort might prove beneficial in estimating the knowledge gap for identifying and comprehending these kinds of relationships.

CONCLUSION

This study shows a significant change in hematological parameter in Malaria patients. These changes not only show the severity of malaria but also consider as a marker for indication of malaria. In district Bannu, percentage of malaria is high in male than female. People with Age group 15-30 is more effected from malaria infection than others. The parameters that were altered the most frequently were HB, platelet count, TLC, and DLC. Thrombocytopenia is second most common

hematological abnormality seen in all 60 cases. In TLC abnormality, rare cases of leukocytosis (high leukocyte count than normal) 8% were noted. In order to lessen the difficulties connected with malaria, patients should have their hematopathological abnormalities, such as anemia and thrombocytopenia, examined for. If abnormalities are found, proper treatment should be started.

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