To Study the Significance of Hematological Parameters in Differentiating Malaria and Non-Malarial Acute Febrile Illness in a Tertiary Care Hospital in Visakhapatnam

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Abstract:

Background: Malaria is a common infectious disease and rarely can be life threatening if not treated properly. It is one of the major health problems in most populated areas of world [1] and an important cause of acute febrile illness in India. According to WHO's latest world Malaria report, there were an estimated 249 million malaria cases in 2022 in 85 malaria endemic countries, increasing from 224 million in 2021.

Method: The study was an observational study carried out in King George Hospital (KGH) Visakhapatnam. The study population were the acute febrile illness patients visiting the outpatient clinic and inpatient unit wards of General Medicine and Pediatric departments. A sample size of 100 patients was taken. Amongst them 40 cases were malaria positive and 60 was found to be suffering with Non-Malarial acute febrile illness.

Results: Out of all 100 cases, 40 were malaria cases, 29 (72.5%) were found to be caused by P. falciparum,5 (12,5%) by P. vivax, 5 (12,5%) were mixed infections caused by both P.falciparum and P.vivax. 1 (2.5%) was caused by P. falciparum and P.ovale.

Conclusion: A better idea about hematological picture in malaria is useful for early initiation of prompt treatment and avoids misuse of anti-malaria drugs and prevents drug resistance. Thrombocytopenia is strong predictor for malaria over non-malarial acute febrile illness.

Keywords: Malaria, Acute febrile illness, P.falciparum and P.vivax.

Introduction

Malaria is a common infectious disease and rarely can be life threatening if not treated properly. It is one of the major health problems in most populated areas of world [1] and an important cause of acute febrile illness in India.

According to WHO's latest world Malaria report, there were an estimated 249 million malaria cases in 2022 in 85 malaria endemic countries, increasing from 224 million in 2021. 29 out of 85 endemic countries accounted for 96% of Malaria cases globally. The estimated number of malarial deaths stood at 608000 in 2022 compared to 610000 in 2021[2].

In India about 21.98% population lives in malaria high transmission areas (≥1case/1000 population) and about 67% in low transmission areas (0-1 case/1000 population). About 92% Malaria cases and 97% deaths due to malaria are reported from North Eastern States, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan, West Bengal and Karnataka[3].

Malaria is caused by protozoan parasite of the genus plasmodium which mainly targets and destroys red blood cells. It is transmitted by the bite of female Anopheles Mosquito. Four species of plasmodium (P.falciparum, P.malariae, P.ovale and P.vivax) cause malaria in humans of which P.falciparum is the major cause of morbidity and mortality [4,5].

Objectives:

1. To study the blood picture and changes in blood parameters in patients suffering with malaria.

2. To identify the differences in hematological parameters in malarial and non-malarial acute febrile illness.

Materials and Methods

The study was an observational study carried out in King George Hospital (KGH) Visakhapatnam. The study population was the acute febrile illness patients visiting the outpatient clinic and inpatient unit wards of General Medicine and Pediatric departments. A sample size of 100 patients was taken. Amongst them 40 cases were malaria positive and 60 were found to be suffering with Non-Malarial acute febrile illness.

Inclusion Criteria: Includes the patients of age 1 - 60 years suffering from acute febrile illness visiting outpatient Clinic and inpatient with valid informed consent.

Exclusion Criteria: Includes the People with chronic long standing fever and low grade fever, People of age <1 year and >60 years, Patients suffering with Hepatitis and NACO+ patients, Patients who were not willing to give their consent.

Statistical Analysis: Data analysis was done by statistical package for the Social Sciences (SSPS) Software version 21 and Microsoft Excel sheets. The statistical analysis was done by unpaired T-test. The p value less than 0.05 (< 0.05) were considered as statistically significant and p value less than 0.01 (< 0.01) were taken highly significant while p value greater than 0.05 (> 0.05) were regarded as non-significant.

Observations and Results: Out of 100 cases 40 cases were malaria positive and 60 were found to be suffering with Non-Malarial acute febrile illness. Out of 40 malaria cases reported, 21 (52.5%) were found in males and 19 (47.5%) were found in females.

Out of 60 non-malarial cases reported, 23 (38.3%) were found in males and 37 (61.7%) were found in females. Out of 40 malarial cases reported, 19 (47.5%) were found in children of 1 – 18 years and 21 (52.5%) were found in adults (19 – 60) age group.

Out of 60 non-malarial cases reported, 17 (28.3%) were found in children of age group 1 – 18 years and 43 (71.7%) were found in adults (19 – 60) age group. Among 40 reported malaria cases, 29 (72.5%) were found to be caused by P. falciparum,5 (12,5%) by P. vivax, 5 (12,5%) were mixed infections caused by both P.falciparum and P.vivax. 1 (2.5%) was caused by P. falciparum and P.ovale.

Hematological Parameters:

Table 1: Baseline characteristics of hematological parameters in patients with and without Malaria

Parameters	Reference Range	With Malaria (N = 40) Mean (±SD)	Without Malaria (N = 60) Mean (±SD)	P Value
RBC (million/mm3)	M-4.5-6 F-4-5.5	2.90(±1.13)	3.63(±1.04)	<0.01
WBC(x 103/mm3)	4-11	9.59(±5.84)	9.81(±11.69)	0.914
Hb(g/dl)	13-18	6.51(±2.49)	9.12(±2.82)	<0.01
Platelet Count(x 105/mm3)	1.5-4	0.89(±0.69)	1.53(±1.23)	<0.01
Neutrophils (%)	50-70	61.23(±13.62)	58.63(±17.23)	0.426
PCV (%)	M-40-50 F-37-47	20.16(±8.48)	28.92(±8.50)	<0.01
MCV (fL)	78-96	70.77(±8.74)	79.04(±10.09)	<0.01
MCH (pg)	27-33	22.31(±3.08)	25.27(±4.08)	<0.01
MCHC (g/dl)	33-37	29.97(±5.28)	31.18(±2.51)	0.127

M – Male, F- Female, fL – Femtolitre, pg – picograms, SD – Standard Deviation.

Discussion:

There was slight male predominance. Most of the studies have reported high burden in males compared to females [6]. There was slight predominance of adult age group than children similar to the study conducted by Malik et al [7]. According to the study conducted by Malik et al, A total 3344 patients with acute febrile illness were included, amongst them 392 (11.72%) were positive for malaria. 160(40.8%) of them were children with age less than 15years and 232 (59.1%) were above 15 years.

There is female predominance in non-malarial patients unlike that seen in malaria where males are predominant. The adults were predominant than children similar to that of malaria patients.

There was the predominance of P.falciparum infection which was similar to the study conducted by TB Lathia, R. Joshi [8] . In the study conducted by TB Lathia, R.Joshi, total of 184 patients of acute febrile illness were included out of them 70 (38%) were positive to malaria and the rest 114 were negative. Among 70 positive patients, P.falciparum was predominant and identified in 64 (91%) patients and the rest of 6 patients (8.5%) were positive for P.Vivax.

Red Blood Cells (RBC): Maximum number of Malaria cases showed anemia which was similar to the study conducted by Neha Chaudhary et al [9]. The study of Neha Chaudhary et al shows, out of all febrile illnesses studied [Malaria, dengue, meningitis, typhoid, UTI and nonspecific fever], malaria showed maximum number of cases of anemia. The low RBC count may be due to the parasite's primary target being RBC's, resulting in an accelerated removal of both parasitized and non-parasitized RBC's. In a study conducted by Price RN et al [10] it was shown that the proportion of the total RBC's that were lost as a direct result of parasitization was estimated to be 79%(95% CI, 6.2 - 9.6%) in uncomplicated falciparum malaria. The 'p' value of RBC is 0.001 which is < 0.01 and is considered highly significant in differentiating malaria from non-malaria.

Total Leucocyte Count (TLC): Both leucopenia and leucocytosis are observed in malaria patients. Even in the study conducted by AM Malik et al [7], both Leucocytosis and leucopenia were observed. The p value of TLC is 0.914 which is > 0.05 and is considered as insignificant in differentiating malaria and non-malaria.

Hemoglobin: In the present study, low Hb levels were seen in malaria patients which is in accordance with the studies conducted by Nfor Omarine Nlinwe,Tang Bertilla Nange[11] , M.Al-Salahy et al[12]. In the study conducted by Nischita Budihal[13], it is concluded that out of all febrile illnesses included in the study, malaria showed maximum number of cases of anemia.

In the present study, Hb came to be significant which is in accordance to the study conducted by M.Kotepui et al [14]. The p value of Hb is < 0.01 which suggests that Hb values are highly significant to differentiate malaria from other febrile illnesses.

Platelets: Low platelet count is a characteristic finding of malarial infection and thrombocytopenia is more common than anemia in acute malarial infection. In this study thrombocytopenia emerged as a strong predictor of Malaria which is in accordance with other studies[6,7,8,15,16]. A study conducted by Shreya kavar et al [17], also concluded that presence of thrombocytopenia in a patient with acute febrile illness in the tropics increases the probability of malaria.

In a study conducted by S.J. Khan et al [18] ; it was concluded that out of 228 patients with the fever and thrombocytopenia, 121 patients were proved to be suffering from malaria and the platelet counts of these patients ranged between 25,000 to 150,000/dl.

A study conducted by Hardik Patel et al [19], concludes that thrombocytopenia was observed most commonly in P.Vivax followed by P.falciparum and mixed infection. Thrombocytopenia was a prominent finding but resolved during or after therapy [20]. It has also been observed that there is an inverse relationship between platelet count and parasite level [21]. The 'p' value of platelet count is 0.004 which is <0.01 and is highly significant.

Neutrophils: The 'p'value of neutrophils is 0.426 which is > 0.05 and is insignificant in differentiating Malaria from non-Malaria patients. Both neutropenia and neutrophilia were seen in malaria patients. In a study conducted by David C Dale, Sheldon M Wolff [22], it was concluded that reduced neutrophil counts were seen in patients with malaria and this might be due to shift of neutrophils from the circulating pool to an enlarged marginal pool. Neutrophilia was found in the peripheral blood of infants and children with acute malaria in a study conducted by Abdalla SH et al [23]. The malarial pigment released by infected red cells during schizogony is phagocytosed by neutrophils. It is concluded that the pigment-containing neutrophil count is a simple marker of disease severity in childhood malaria in addition to the parasite count [24].

Packed Cell Volume (PCV): The p value of PCV is less than 0.01 which is highly significant. In a study conducted by Neha Chaudhary et al [9] and Subhashini srinivas et al [25] , it was shown that mean PCV value was less in malaria patients compared to Dengue.

Mean Corpuscular Volume (MCV): The p value of MCV is < 0.01 which suggests it is highly significant. In this study the mean MCV value for malaria patients is less than to that seen in the non-malaria patients.

The study conducted by Inam ullah et al [26] also shown lesser MCV values in malarial patients. In another study conducted by M. Kotepui et al [14] , MCV values in malaria patients are significantly higher than non-malaria group which is contrary to this study.

Mean Corpuscular Hemoglobin (MCH): The p value of MCH is < 0.01 and is highly significant. The MCH values were significantly less in malaria patients which were in accordance with the study conducted by N.Agarwal et al [27]. N Choudhary et al [9] also noted that MCH values are significantly lower in malaria patients over dengue. M. Kotepui et al [14] noted that MCH values are higher in the Malaria patients when compared to non-malaria which is contrary to the study.

Mean Corpuscular Hemoglobin Concentration (MCHC): The p value of MCHC is 0.127 which is >0.05 and is considered insignificant.M. Kotepui et al [14] noted that MCHC values are high in malaria

over non-malarial patients. In his study he noted the median value of MCHC as 32.6 in falciparum malaria, 32.5 in vivax malaria and 26.3 in non-malarial patients. The median MCHC values are high in malaria which is in contrast to this study.

Conclusion

A better idea about hematological picture in malaria is useful for early initiation of prompt treatment and avoids misuse of anti-malaria drugs and prevents drug resistance. Thrombocytopenia is strong predictor for malaria over non-malarial acute febrile illness.

The parameters like low RBC, Hb, Platelets, PCV, MCH, MCV are significant in differentiating malaria from non-malarial febrile illnesses. TLC count, Neutrophil count and MCHC are not much reliable for diagnosis of malaria.

Hematological analysis can help in diagnosis of malaria, however the diagnosis can be made more accurate by detection of malarial parasites by microscopy or Rapid Diagnostic tests.

This hematological analysis will be better helpful in remote /tribal areas where advanced techniques are not available. In such places they can help in early diagnosis and can reduce the severity of the disease.

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