

## Hematological Parameters in Various Acute Febrile Illnesses: A Comparative Study

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### Abstract

**Background:** Malaria, dengue, typhoid, chikungunya fever, meningitis, urinary tract infections (UTIs), and other atypical diseases are major causes of acute febrile illnesses (AFIs).

**Aim:** Identify which haematological variables are more likely to lead to a provisional diagnosis of a variety of acute febrile illnesses and trigger the initiation of a particular treatment.

**Methods:** From January 2020 to June 2020, a prospective study was done at Department of Pathology, Darbhanga Medical College, Laheriasarai, Bihar. It comprised 300 instances of acute febrile infections in patients between the ages of 18 and 58. For each patient, a complete blood count and a malarial parasite microscopy were done. Where necessary, additional pertinent tests were performed to confirm the diagnosis.

**Results:** Malaria was found in 17%, dengue in 28%, typhoid in 16.3%, UTI in 14.7%, meningitis in 7%, and non-specific fever in 17% of the 300 cases of AFI. There were 159 males out of 300 and 141 females. The age range of 18 to 28 years saw the highest percentage of cases (43%) overall. Malaria was associated statistically significantly with thrombocytopenia, anaemia, increased red cell and platelet distribution widths, and decreased packed cell volume (PCV). In *P. falciparum* compared to *P. vivax*, thrombocytopenia, anaemia, and decreased RBC and PCV were all seen. Platelet count drop, leucopenia with lymphocytosis, and a reduction in PCV in 56% of dengue cases were all detected. Increases in TLC and neutrophil count were common symptoms of meningitis and UTI. When compared to malaria, patients with typhoid had a normal platelet count, a slight anaemia, and a mildly reduced PCV.

**Conclusion:** In patients with acute febrile illness, commonly performed laboratory tests such haemoglobin, PCV, leukocyte count, platelet count, and even red cell indices can serve as diagnostic markers.

**Keywords:** Dengue, Malaria, Thrombocytopenia, Typhoid.

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## Introduction

Acute febrile illness (AFI) is defined as a fever lasting at least two days with a body temperature of 38°C or above. Malaria, dengue, typhoid, chikungunya fever, meningitis, urinary tract infection, and other diverse diseases are typical causes of acute febrile illnesses [1]. Studies have found that when the disease advances in malaria patients, haematological alterations do occur, leading to anaemia and thrombocytopenia. Similar to how it happens in dengue patients, a blood test can also reveal a reduction in platelet counts [2].

Leucopenia with relative lymphocytosis is one of the haematological symptoms of typhoid [3]. Leukocytosis is a typical observation in both bacterial meningitis and UTI [4,5]. The current study aims to determine whether specific haematological changes increase the likelihood of arriving at a provisional diagnosis of a variety of acute febrile illnesses and kicking off specific therapy without much delay [6]. Hematological changes are the measurable parameters of blood that can be easily determined by blood examination.

## Material and Methods

From January 2020 to June 2020, a prospective study was done at Department of Pathology, Darbhanga Medical College, Laheriasarai, Bihar. The study comprised 300 cases of acute febrile infections in patients between the ages of 18 and 58 who were hospitalised to the DMCH's In-Patient-Department (IPD). Since all of these situations included admitted patients, where consent is automatically given for standard examinations, blood draws, and other testing, and since just the data from the procedures were utilised to determine the identity of the patients, separate consent was not necessary.

Patients having septicaemia, transfusion reactions, allergic/drug responses, and fever for at least two days in a row with a

temperature  $\geq 38^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) were not included in the study. Patients who met the criteria for selection had thorough histories obtained. Clinical results were reported after a thorough clinical examination. In EDTA vacuum tubes (2 mg/ml of blood), venous blood samples for CBC and General Blood Picture (GBP) were obtained. An automatic 5-part complete digital haematological analyzer was used to do the CBC. Leishman's stain was used to generate thin blood smears, which were then examined for the presence of GBP and malarial parasites.

When additional testing was required, quantitative buffy coat (QBC) and rapid diagnostic tests were performed for the confirmation of malaria. IgM/IgG antibody testing and a commercial antibody-capture NS1 antigen assay were used to confirm dengue. The Widal tube test and the Typhoid IgG/IgM test were used to confirm typhoid. A clean catch midstream urine sample containing pus cells  $>5/\text{hpf}$  with and without bacilli was regarded as positive for a UTI [7]. TLC  $>5$  cells/ $\text{mm}^3$  in CSF was regarded as a meningitis-positive indicator [8]. The Dacie and Lewis Practical Hematology, 9th Edition [9] was used to determine the normal reference ranges for haematological parameters.

Version 10 of the Statistical Package for the Social Sciences (SPSS) was used to analyse the data. Using the Independent 't' Test and the chi-square test, the statistical analysis was carried out. When the p value was less than 0.05, it was deemed statistically significant, and when it was greater than 0.05, it was deemed extremely significant.

## Result

Out of the 300 cases of AFI, dengue was found in 84 (28%) patients, malaria in 51 (17%), typhoid in 49 (16.3%), urinary tract infection in 44 (14.7%), meningitis in 21 (7%), and non-specific fever in 51 (17%)

patients. Male patients made up 53% of all patients, compared to female patients' 47%. The age range of 18 to 28 years had the

highest percentage of patients (43%), followed by the age range of 29 to 38 years (23.6%) [Table -1].

**Table 1: Etiology based distribution of patients in different age (n=300).**

Age groups (yrs.)	Malaria	Typhoid	Dengue	UTI	Meningitis	Non-specific	Total No. of Cases (%)
Group I (18-28)	28	13	38	17	9	24	129(43%)
Group II (29-38)	15	15	16	6	6	13	71(23.6%)
Group III (39-48)	4	13	14	10	2	7	50(16.7%)
Group IV (49-58)	4	8	16	11	4	7	50(16.7%)
Total No. of cases	51	49	84	44	21	51	300

P value= 0.112 (>0.05) non-significant –chi square test

Malaria had the highest percentage (74.5%) of cases with haemoglobin below 11 g/dl of any febrile illness. Maximum (27) of the 48 patients who had leucopenia also had dengue. Meningitis patients (81%) had the highest neutrophil counts, followed by UTI patients (63.6%). Dengue patients had the highest percentage of lymphocytosis (37%) [Table-2]. The majority (56%) of dengue cases had platelet counts under 50000/mm<sup>3</sup>, while the majority (39.3%) of malaria cases had platelet counts between 50000 and 100000/mm<sup>3</sup> (Table 3). Malaria (78.4%) and UTI (72.7%) accounted for the majority of cases of decreased PCV, respectively (Table 4). Among all AFI, the normocytic normochromic blood picture (67.7%) predominated.

**Table 2: Comparison of hemoglobin, WBC, neutrophil and lymphocyte count in various acute febrile illnesses (n=300). In all parameters p value <0.01 highly significant -chi square test**

Parameters	Malaria (n=51)	Typhoid (n=49)	Dengue (n=84)	UTI (n=44)	Meningitis (n=21)	Non-specific (n=51)	Total	
Hemoglobin (<11gm/dl)	38 (74.5%)	25 (51.0%)	34 (40.5%)	28 (63.6%)	11 (52.3%)	14 (27.4%)	150 (50.0%)	300
Hemoglobin (>11gm/dl)	13 (25.5%)	24 (49.0%)	50 (59.5%)	16 (36.4%)	10 (47.7%)	37 (72.5%)	150 (50.0%)	
Low WBC (<4×10 <sup>3</sup> /mm <sup>3</sup> )	8 (15.6%)	9 (18.4%)	27 (32.1%)	1 (2.3%)	2 (9.5%)	1 (2.0%)	48 (16.0%)	300
Normal WBC (4×10 <sup>3</sup> /mm <sup>3</sup> - 11×10 <sup>3</sup> /mm <sup>3</sup> )	37 (72.5%)	30 (61.2%)	44 (52.4%)	28 (63.6%)	11 (52.4%)	46 (90.1%)	196 (65.3%)	
High WBC (>11×10 <sup>3</sup> /mm <sup>3</sup> )	6 (11.7%)	10 (20.4%)	13 (15.5%)	15 (34.1%)	8 (38.1%)	4 (7.9%)	56 (18.7%)	
Neutrophil Count (>70%)	24 (47.0%)	24 (49.0%)	23 (27.4%)	28 (63.6%)	17 (81.0%)	11 (21.6%)	127 (42.3%)	300
Neutrophil Count (<70%)	27 (53.0%)	25 (51.0%)	61 (72.6%)	16 (36.4%)	4 (19.0%)	40 (78.4%)	173 (57.7%)	
Lymphocyte Count (>40%)	8 (15.6%)	9 (18.4%)	31 (37.0%)	1 (2.3%)	1 (4.8%)	12 (23.5%)	62 (20.7%)	300
Lymphocyte Count (<40%)	43 (84.4%)	40 (81.6%)	53 (63.0%)	43 (97.7%)	20 (95.2%)	39 (76.5%)	238 (79.3%)	

**Table 3: Comparison of platelet count in various febrile illnesses (n=300).**

Platelet Count	Malaria	Typhoid	Dengue	UTI	Meningitis	Non-specific	Total
(<50000/mm <sup>3</sup> )	17(33.3%)	2(4.1%)	47(56.0%)	1(2.3%)	1(4.8%)	1(2.0%)	69(23.0%)
(50000-100000/mm <sup>3</sup> )	20 (39.3%)	2 (4.1%)	27 (32.1%)	0	2 (9.5%)	1 (2.0%)	52 (17.3%)
(100001-150000/mm <sup>3</sup> )	7 (13.7%)	6(12.2%)	2(2.4%)	4(9.1%)	2(9.5%)	1(2.0%)	22 (7.4%)
(150001-450000/mm <sup>3</sup> )	7 (13.7%)	39 (79.6%)	8 (9.5%)	39 (88.6%)	16 (76.2%)	48 (94.0%)	157 (52.3%)
Total	51	49	84	44	21	51	300

**Table 4: Comparison of PCV in various febrile illnesses (n=300).**

PCV (%)	Malaria	Typhoid	Dengue	UTI	Meningitis	Non-specific	Total
Low (F<36) (M<40)	40(78.4%)	34(69.4%)	47(56.0%)	32(72.7%)	14(66.7%)	12(23.5%)	158(52.7%)
Normal (F=36-46) (M=40-50)	11(21.6%)	14(28.6%)	32(38.1%)	12(27.3%)	7(33.3%)	38(74.5%)	135(45.0%)
Raised (F>46) (M>50)	0	1(2.0%)	5(5.9%)	0	0	1(2%)	7(2.3%)
Total	51	49	84	44	21	51	300

In the current study, when haematological parameters were examined between dengue and malaria patients, the mean platelet count, mean RDW, and mean neutrophil count were significantly lower in dengue patients than in malaria patients. In contrast, dengue patients had higher mean Hb, mean PCV, mean MCV, mean MCH, and mean MCHC levels. In contrast to malaria, meningitis patients had significantly higher mean WBC and mean neutrophil counts. Malaria was associated with thrombocytopenia and elevated PDW, but meningitis was associated with a normal platelet count and relative lymphopenia. Comparing malaria to typhoid, statistically significant traits included thrombocytopenia, anaemia, and higher PDW. In typhoid cases, the mean platelet count was within the normal range. Typhoid cases had higher mean PCV values than malaria positive ones. In comparison to malaria patients, UTI patients had higher mean WBC and mean neutrophil counts. Malaria was associated with thrombocytopenia and elevated PDW, but UTI was associated with a normal platelet count and relative lymphopenia. The majority of cases of non-specific fever had haematological values that were within normal limits [Table -5].

**Table 5: Comparison of hematological parameters in various acute febrile illnesses. (\*p value <0.05, § p value <0.01 - Independent 't' Test).**

Hematological Parameters (Mean values)	Malaria (n=51)	Typhoid (n=49)	Dengue (n=84)	UTI (n=44)	Meningitis (n=21)	Non-specific (n=51)
Mean Hb (gm/dl)	9.71	11.20*	11.98§	10.62	10.60	12.71§
Mean PCV (%)	30.05	34.36*	35.38*	33.21	32.84	40.71§
Mean WBC (×10 <sup>3</sup> /mm <sup>3</sup> )	6.74	7.67	6.51	11.64§	9.48§	7.48

Mean Neutrophil Count (%)	67.14	67.90	61.56*	72.20*	80.05 <sup>§</sup>	63.00*
Mean Lymphocyte Count (%)	31.49	28.27	35.57	21.11 <sup>§</sup>	18.38 <sup>§</sup>	32.37
Mean Monocyte Count (%)	0.27	0.51	0.42	0.09	0.10	0.16
Mean Eosinophil Count (%)	1.28	3.33 <sup>§</sup>	2.50 <sup>§</sup>	3.67 <sup>§</sup>	1.48	4.57 <sup>§</sup>
Mean Basophil Count (%)	0	0	0	0	0	0
Mean RBC ( $\times 10^6/\text{mm}^3$ )	3.62	3.96	□□□□	3.98	3.97	4.62 <sup>§</sup>
Mean RDW (%)	15.35	14.65	12.94 <sup>§</sup>	14.24 <sup>§</sup>	15.77	15.92
Mean MCV ( $\mu\text{m}^3$ )	86.06	87.96	92.13 <sup>§</sup>	84.20	83.19	87.71
Mean MCH (pg)	27.84	28.75	31.32 <sup>§</sup>	26.96	26.85	27.66
Mean MCHC (gm/dl)	32.17	32.49	33.81 <sup>§</sup>	31.93	31.99	31.33 <sup>§</sup>
Mean Platelet Count (/mm <sup>3</sup> )	88058.52	250693.88 <sup>§</sup>	62916.67*	268915.91 <sup>§</sup>	303142.86 <sup>§</sup>	264764.71 <sup>§</sup>
Mean MPV ( $\mu\text{m}^3$ )	10.25	9.83 <sup>§</sup>	9.82	10.00	9.54	9.88
Mean PDW (%)	22.98	18.81	23.02	18.31 <sup>§</sup>	18.28 <sup>§</sup>	18.05 <sup>§</sup>

## Discussion

Malaria in our study had the highest incidence of anaemia among all febrile diseases. Hemolysis of parasitized RBCs, inefficient erythropoiesis, and decreased RBC deformability, which results in splenic pooling and phagocytosis, can all contribute to anaemia in malaria [10]. Additionally, increased RDW was seen in cases of malaria, which may be related to red cell response to the parasite and macrocytosis [11].

The majority of dengue cases had platelet counts below 50000/mm<sup>3</sup>, whereas the majority of malaria cases had platelet counts between 50000 and 100000/mm<sup>3</sup>. Similar studies were conducted on 398 AFI patients by Chrispal A *et al* [12] and on 1962 AFI patients by Bottieau E *et al* [13] In both studies, dengue and malaria revealed moderate to severe thrombocytopenia. Thrombocytopenia may be caused by the

bone marrow depression seen in dengue fever during the acute stage. Additionally, dengue virus infection of megakaryocytes directly may enhance the death of platelet cells [14]. Thrombocytopenia appears to be brought on by immune-mediated destruction of circulating platelets, platelet consumption by DIC, and peripheral as well as splenic platelet destruction in malaria patients [15].

The mean platelet count, mean RDW, and mean neutrophil count in dengue patients were significantly lower than those in malaria patients when comparing haematological characteristics between the two diseases. In contrast, dengue patients had higher mean Hb, mean PCV, mean MCV, mean MCH, and mean MCHC values than malaria patients. In a study conducted by Sethi B *et al* [10], similar outcomes were seen.

Meningitis and UTI patients had higher mean WBC and mean neutrophil counts than malaria patients did. Typhoid patients had greater mean Hb, mean PCV, and mean platelet counts than malaria patients did when the two diseases were compared. However, compared to typhoid patients, mean PDW values were higher in malaria patients. In their investigation of 200 typhoid patients, Emenuga VN *et al* [16] likewise noted a decline in mean haemoglobin count. Dangana A *et al* [17]. reported mean PCV 34.14% in a research conducted among 200 cases of enteric fever, which is comparable to our data. In their research on typhoid patients, Abro AH *et al* [18] and Chrispal A *et al.*<sup>[12]</sup> observed that the platelet count was within the normal range.

### Conclusion

We found a statistically significant link between malaria and haematological alterations such thrombocytopenia, anaemia, increased RDW and PDW, although lower PCV did not. When dengue patients were compared to malaria patients, there was a greater decline in platelet count, leucopenia, and a relative rise in lymphocyte count, mean MCV, mean MCH, and mean MCHC in dengue patients than in malaria patients. It was discovered that a rise in TLC and neutrophil count might distinguish malaria from UTI and meningitis when compared to those conditions. A normal platelet count, a moderate anaemia, and a mildly decreased PCV were diagnostic indicators of typhoid when compared to malaria. We come to the conclusion that in patients with acute febrile illness, commonly used laboratory results like haemoglobin, leukocyte and platelet count, and even red cell indices can serve as diagnostic indicators, increasing the likelihood of a proper disease diagnosis and promoting quick treatment initiation.

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