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Hematological parameters in fever evaluation - A prospective study

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Abstract

Introduction: The common causes of acute febrile illnesses (AFI) are malaria, dengue, typhoid, Chikungunya fever, meningitis, Urinary Tract Infection (UTI) and other miscellaneous diseases.

Aim: To detect if certain hematological parameters would increase the probability to reach a provisional diagnosis of various acute febrile illnesses and prompt institution of specific therapy.

Materials and Methods: This prospective study was conducted in Department of Pathology, for 2 years in Sri Siddhartha Medical College, TUMKUR, from June 2016 to May 2018 and included total 100 cases of acute febrile illnesses in age group 21 to 60 years. Complete blood count and malarial parasite microscopy were performed for each patient. Other relevant tests wherever required, were done for confirmation of diagnosis.

Results: Among 100 cases of AFI, malaria was detected in 17%, dengue in 26%, typhoid in 16%, UTI in 17%, meningitis in 6% and non-specific fever in 18%. There were 55/100 males and 45/100 females. Maximum number of cases (44%) were seen in age group 21 to 30 years. Thrombocytopenia, anemia, increased Red Cell Distribution Width (RDW) and Platelet Distribution Width (PDW) while reduced Packed cell volume (PCV) showed a statistically significant correlation in malaria. A relatively more thrombocytopenia, anemia and reduced RBC and PCV were noted in *P. falciparum* in comparison to *P. vivax*. In dengue, a more reduction in platelet count, leucopenia with lymphocytosis and 56% cases with reduced PCV were noted. Increase in TLC and neutrophil count was consistent features seen in UTI and meningitis. In typhoid patients normal platelet count, mild anemia and mildly reduced PCV was observed while comparing with malaria.

Conclusion: We conclude that routinely used laboratory tests such as hemoglobin, PCV, leukocyte count, platelet count and even red cell indices can act as diagnostic indicators in patients with acute febrile illness.

Keywords: hematological, fever evaluation and urinary tract infection

Introduction

Acute febrile illness (AFI) is fever of at least two consecutive days with body temperature $>38^{\circ}\text{C}$. The common causes of acute febrile illnesses are malaria, dengue, typhoid, chikungunya fever, meningitis, urinary tract infection and other miscellaneous diseases [1]. Studies have observed that among malaria patients hematological changes do take place resulting in anemia and thrombocytopenia, as the disease progresses. Likewise in case of dengue patients decrease in platelet counts takes place which can also be determined by blood test. Hematological parameters in typhoid include leucopenia with relative lymphocytosis. In the same way leukocytosis is common finding in UTI and bacterial meningitis. Based on these hematological changes which are the measurable parameters of blood and can be easily ascertained by blood examination, the present study aims to detect if certain hematological changes do increase the probability to reach a provisional diagnosis of various acute febrile illnesses and initiate specific therapy without much delay.

Materials and methods

This prospective study was conducted in Department of Pathology, for 2 years in SSMC, TUMKUR, from June 2016 to May 2018. Ethical committee approval was obtained for conducting the study. Total 100 cases of acute febrile illnesses in age group 21 to 60 years admitted in In-Patient-Department (IPD) of our Hospital were included in the study. Because all these cases were of admitted patients, where by default permission for routine examination, blood and other tests is taken, and also as identity of patient is not revealed only

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their test result data are used, therefore separate consent was not required.

Patient with fever for at least 2 consecutive days with temperature ≥ 38 °C (100.4°F) were included in the study, whereas patients with septicemia, transfusion reaction and allergic / drug reactions were excluded. Detailed history was taken of patients fulfilling the selection criteria. Complete clinical examination was done and clinical findings were noted. Venous blood sample for CBC and General blood picture (GBP) were collected in EDTA vacuum tubes (2mg/ml of blood). CBC was done by automatic 5- parts full digital hematology analyzer SYSMEX. Thin blood smears were prepared, stained with Leishman's stain and studied for GBP and malarial parasite identification. Other test-Quantitative buffy coat (QBC) and Rapid diagnostic test were also done for malaria confirmation whenever needed. Dengue was confirmed by IgM/ IgG antibody test and commercial antibody-capture NS1 antigen test. Typhoid was confirmed using Widal tube test and Typhoid IgG/IgM test. Pus cells >5 /hpf with and without bacilli in a clean catch midstream urine sample was considered positive for UTI [7]. TLC >5 cell/mm³ in CSF was considered positive for meningitis. Normal reference ranges of hematological parameters were taken from Dacie and Lewis practical hematology 9th edition.

Data analysis was done by Statistical Package for the Social Sciences (SPSS) version 10. The Statistical analysis was done by using Independent 't' Test and chi- square test. The p value < 0.05 was considered as statistically significant and p value < 0.01 was taken as highly significant while p value >0.05 was regarded as non significant.

Result

Out of total 100 cases of AFI, dengue was detected in 26 (26%), malaria in 17 (17%), typhoid in 16 (16%), UTI in 17 (17%), meningitis in 6 (6%) and 18 (18%) patients were of non-specific fever. Number of male patients (55%) predominated the number of female patients (45%). Maximum number of patients (44%) was in age group 21-30yrs, followed by 22% in the age group of 31-40yrs.

Among all febrile illnesses, malaria showed maximum number of cases with hemoglobin below 11gm/dl. patients showing leucopenia, maximum were suffering from dengue. Patients of meningitis showed maximum neutrophilia followed by UTI. Lymphocytosis was seen maximum in dengue patients. It was noted that majority of cases of dengue had platelet count less than 50000/mm³, while malaria showed maximum cases with platelet count between 50000-100000/mm³. Maximum cases of reduced PCV were of malaria, followed by UTI, Normocytic normochromic blood picture predominated among all AFI.

In present study while comparing hematological parameters among malaria and dengue, mean platelet count, mean RDW and mean neutrophil count was much less in dengue patients as compared to malaria. Whereas, the values of mean Hb, mean PCV, mean MCV, mean MCH and mean MCHC were higher in dengue patients. The values of mean WBC and mean neutrophil were significantly higher in meningitis patients as compared to malaria. Thrombocytopenia with increased PDW was noted in malaria while normal platelet count and relative

Table 1: Age Distribution

Age groups (yrs)	Malaria	Typhoid	Dengue	UTI	Meningitis	Non-specific	Total No. of cases
Group I (21-30)	9	5	13	6	3	8	44(44%)
Group II (31-40)	5	4	5	2	2	4	22(22%)
Group III (41-50)	2	3	4	4	1	3	17 (17%)
Group IV (51-60)	1	4	4	5	0	3	17 (17%)
Total No. of cases	17	16	26	17	6	18	100

Table 2: RBC and WBC Parameters

Parameters	Malaria (n=17)	Typhoid (n=16)	Dengue (n=26)	UTI (n=17)	Meningitis (n=6)	Non-specific fever (n=18)	Total
Hemoglobin (<11 gm/dl)	12	8	10	10	3	7	50
Hemoglobin (>11 gm/dl)	4	8	15	6	3	14	50
Low WBC (<4x10 ³ /mm ³)	3	3	8	1	1	1	17
Normal WBC (4x10 ³ /mm ³ -11x10 ³ /mm ³)	12	10	14	11	3	15	65
High WBC (>11x10 ³ /mm ³)	2	3	4	5	2	2	18
Neutrophil Count (>70%)	8	8	7	11	5	4	43
Neutrophil Count (<70%)	9	8	19	6	1	14	57
Lymphocyte Count (>40%)	3	3	10	1	1	5	23
Lymphocyte Count (<40%)	14	13	15	16	5	14	77

Table 3: Platelet Count

Platelet Count	Malaria	Typhoid	Dengue	UTI	Meningitis	Non-specific	Total
(<50000/mm ³)	6	1	14	1	1	1	24
(50000/mm ³ -100000 /mm ³)	7	1	8	0	1	1	18
(100001/mm ³ -150000/mm ³)	2	2	1	1	1	1	8
(150001/mm ³ -450000/mm ³)	2	12	3	15	3	15	50
Total	17	16	26	17	6	18	100

Table 4: Packed Cell Volume (Pcv)

PCV (%)	Malaria	Typhoid	Dengue	UTI	Meningitis	Non-specific	Total
Low (F<36) (M<40)	13	11	16	12	4	4	60
Normal (F=36-46) (M=40-50)	4	4	9	4	2	13	36
Raised (M>50) (F>46)	0	1	1	1	0	1	4
Total	17	16	26	17	6	18	100

Table 5: Hematological Parameters

Hematological Parameters (Mean values)	Malaria (n=17)	Dengue (n=26)	Meningitis (n=6)	Typhoid (n=16)	UTI (n=17)	Non specific fever (n=18)
Mean Hb (gm/dl)	9.79	11.78	10.50	11.10	10.52	12.61
Mean PCV (%)	30.25	35.38	31.84	35.36	33.61	40.71
Mean WBC (x 103/mm3)	6.74	6.51	9.48	7.67	11.64	7.48
Mean Neutrophil count (%)	67.14	61.56	80.05	67.90	72.20	63.00
Mean Lymphocyte count (%)	31.49	35.57	18.38	28.27	21.11	32.27
Mean Monocyte count (%)	0.27	0.42	0.10	0.51	0.09	0.16
Mean Eosinophil count (%)	1.28	2.50	1.48	3.33	3.67	4.57
Mean Basophil count (%)	0	0	0	0	0	0
Mean RBC (x 106/mm3)	3.62	3.91	3.97	3.96	3.98	4.62
Mean RDW (%)	15.35	12.94	15.77	14.65	14.24	15.92
Mean MCV (μm^3)	86.06	92.13	83.19	87.96	84.20	87.71
Mean MCH (pg)	27.84	31.32	26.85	28.75	26.96	27.66
Mean MCHC (gm/dl)	32.17	33.81	31.99	32.49	31.93	31.33
Mean Platelet count (/mm3)	90058.82	71916.67	313142.86	251693.88	269915.91	265764.71
Mean MPV (μm^3)	10.25	9.82	9.54	9.83	10.00	9.88
Mean PDW (%)	22.98	23.02	18.28	18.81	18.31 §	18.05

lymphopenia was observed in meningitis. Thrombocytopenia, anemia and increased PDW were statistically significant features noted in malaria as compared to typhoid. Mean platelet count was within normal limit in typhoid cases. Mean PCV values were higher in typhoid in comparison to malaria positive cases. The values of mean WBC and mean neutrophil count were higher in UTI patients as compared to Malaria patients. Thrombocytopenia with increased PDW was noted in malaria while normal platelet count and relative lymphopenia was observed in UTI. In non-specific fever, the hematological parameters were within normal range in majority of cases.

Discussion

In our study, out of all febrile illnesses, malaria showed maximum number of cases of anemia. Anemia in malaria can be due to hemolysis of parasitized RBC's, ineffective erythropoiesis, decreased RBC deformability which causes splenic pooling and phagocytosis. Increased RDW was also observed in malaria, which could be due to macrocytosis and red cell response to malarial parasite.

Majority of cases of dengue had platelet count less than 50000/mm³, while malaria showed maximum cases with platelet count between 50000-100000/mm³. In similar studies done by Chrispal A *et al.*, in 398 patients of AFI and Bottieau E *et al.*, in 1962 patients of AFI, dengue and malaria showed moderate to severe thrombocytopenia. The bone marrow depression observed in dengue fever in the acute stage may account for thrombocytopenia. In addition, direct infection of megakaryocyte by dengue virus could lead to an increased destruction of platelet cells. In patients of malaria thrombocytopenia seems to occur due to peripheral as well as splenic destruction of platelets, immune mediated destruction of circulating platelets and platelet consumption by process of DIC.

While comparing hematological parameters among malaria and dengue, mean platelet count, mean RDW and mean neutrophil count was much less in dengue patients as compared to malaria. Whereas the values of mean Hb, mean PCV, mean MCV, mean MCH and mean MCHC were higher in dengue patients as compared to malaria. Similar results were seen in study done by Sethi B *et al.*, The values of mean WBC and mean neutrophil count were higher in meningitis and UTI patients as compared to Malaria. When malaria was compared with typhoid, the values of mean Hb, mean PCV, mean platelet count were higher in typhoid infected patients as compared to malaria. But values of mean PDW were higher in malaria patients as compared to typhoid. Emenuga VN *et al.*, in their study among 200 typhoid patients also reported a decrease in mean hemoglobin count. Similar to our study, Dangana A *et al.*, noted mean PCV 34.14% in a study conducted among 200 cases of enteric fever. Abro AH *et al.*, and Chrispal A *et al.*, in their studies on typhoid patients reported platelet count to be in normal range.

Limitations

As only IPD patients were included in the present study, no Out Patient Department (OPD) patients were included due to lack of patients follow-up, hence we could not assess the effect of different strains of disease causing organisms on various hematological parameters in a specified period of time.

Conclusion

We observed that hematological changes such as thrombocytopenia, anemia, increased RDW and PDW, while reduced PCV showed a statistically significant correlation with malaria. When malaria was compared to dengue, a more reduction in platelet count, leucopenia and a relative increase in lymphocyte count, mean MCV, mean

MCH and mean MCHC in dengue patients as compared to malaria increases the probability of dengue infection. While comparing malaria with UTI and meningitis, it was observed that an increase in TLC and neutrophil count could discriminate malaria from UTI and meningitis. When typhoid was compared to malaria, a normal platelet count, mild anemia and mildly reduced PCV provided diagnostic clues towards typhoid. We conclude that routinely used laboratory findings such as hemoglobin, leukocyte and platelet count and even red cell indices can act as diagnostic indicators in patients with acute febrile illness, thus increasing the probability of correct diagnosis of disease and enhancing prompt initiation of treatment.

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