HEMATOLOGICAL CHANGES IN PATIENTS OF MALARIA

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Received: August 1, 2010; Revised: August 25, 2010; Accepted: August 30, 2010

Abstract: Malaria is an epidemiological problem at the global level. In Indian sub continent it is a major cause of mortality in immunosuppressed patients and in extreme ages of life. Our study is based on early detection of malaria by hematological parameters. A study on 287 malaria patients was carried out at P.D.U Medical College, Rajkot between 1st July 2009 to 31st December 2009 with an objective to detect (a) the most common species causing malaria in Rajkot district, (b) to see the overall hematological changes in patients, (c) to identify the species specific changes and (d) to determine hematological parameters which could guide in diagnosis of malaria. The study showed that Plasmodium falciparum (P. falciparum) as the most common species specific malaria. Most of the infected cases showed anemia, elevated erythrocyte sedimentation rate (ESR), and thrombocytopenia as common hematological changes. These hematological values were decreased as compared to control (normal person) in P. falciparum infection than in Plasmodium vivax (P. vivax) infection.

Key words: Malaria, P. falciparum, P. vivax, Hematological changes

INTRODUCTION

Malaria is an acute, recurrent and sometimes chronic vector borne protozoan disease which has worldwide distribution in tropical and subtropical regions [1-3]. Infection is caused by a parasite of genus Plasmodia which is transmitted to human beings by a pre infected female anopheline mosquito [4]. Genus Plasmodium has 4 species- P. vivax (PV), P. falciparum (PF), P. malariae and P. ovale. In India, P. vivax and P. falciparum are the species commonly found.

In spite of worldwide efforts to reduce malaria transmission, it is still the major cause of morbidity and mortality, with overall fatality rate of 10-30 % [5] was seen. The main areas where disease predominates are the rural and remote areas, where prompt treatment is not available or not detected in time [6].

Malarial parasite affects multiple organs of the body like liver, spleen, brain, gastro intestinal tract (G.I.T), gall bladder, pancreas, blood vessels and placenta. So, the clinical picture could be wide spectrum ranging from simple malaise to life threatening CNS symptoms like coma. Different organs get involved in various ways like parasitic sequestration in the internal organs, intravascular and immune mediated destruction of RBCs and platelets and cytokine mediated injury [7].

As the target of malarial parasite is RBC, peripheral blood smear examination is the major diagnostic tool of the disease. Some hematological changes are species specific. Thrombocytopenia is a common and early sign of malarial infection. [5]. Thus if hematological changes are noticed in time, the path of the disease and henceforth the outcome can surely be modified is the motto of the present study.

MATERIAL AND METHODS

The present study was done in malaria positive patients for six months period. The details of patients including name, age, sex, date of admission, ward in hospitalized patients and OPD unit in outdoor patients
were noted. History was elicited for fever, jaundice, convulsions, nausea, vomiting, duration and progress and history of bleeding from any site as well as drug history and similar complaints in the past and family history were noted.

The diagnosis of malaria was established on peripheral blood film examination. Further samples were collected in ethylene diamine tetra acetic acid (EDTA) and citrated tubes as anticoagulant for complete blood count (CBC) examination, ESR and prothrombin time (PT). Thin film was stained with Leishman’s stain. Thick smears were stained with Giemsa stain and grading of parasitemia was done. Thin and thick films were made on different slides by method described by Dacie and Lewis [8]. Grading is as follows: 1-10 parasites per 100 thick film high power field (HPF): +; 11-100 parasites per 100 thick film HPF: ++; 1-10 parasites per one thick film HPF: +++; >10 parasites per one thick film HPF: ++++

Initial 56 samples were estimated manually. Hemoglobin (Hb) estimation was done colorimetric ally, total white blood cell (WBC) count and platelet count were done using Neubaer’s chamber. Another 233 samples were tested on automated cell counter with complete profile including Hb, total WBC count, RBC count, hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), mean platelet volume, plateletcrit and platelet distribution width. In 2 samples, the platelet indices could not be obtained due to instrumental error. In all samples differential WBC count was done from peripheral blood film by counting 100 WBCs. Corrected WBC count was applied wherever required as follows:

Corrected WBC Count =

Calculated TC - (Calculated TC x % of Nucleated RBC) / 100

ESR samples were collected in sodium citrated anticoagulant tubes and done by Westergens method [9]. Reticulocyte count was done from smear stained with new methylene blue by prescribed method [10].

Reticulocyte index/ Corrected reticulocyte count =

Observed reticulocytes x Measured Hb/PCV / Appropriate normal Hb/ PCV.

Prothrombin time was done in 41 cases by manual method [11] because of intermittent unavailability of the kit.

RESULTS AND DISCUSSION

The present study was carried out between July-December 2009 (six months period) in which 287 number of malaria patients were studied primarily on peripheral blood smear examination.

Month wise distribution of species of malarial parasite: Figure 1 shows month and species wise distribution of malarial parasite. It is evident that 70.6% of cases infected with P. falciparum and 28.7% of cases with P. vivax infection out of the total 100 cases which is comparable to the study carried out by Shah et al. [12], at Ahmedabad in 2007 which showed 80% of cases infected with P. falciparum and 18.67% of cases infected with P. vivax of the total 100 cases studied.

Age wise distribution: Age wise distribution in the present study showed that 82.6% patients were adults (12-60 years), 12.2% pediatric (<12 years) and 5.2% were geriatric (>60 years) which was comparable to study by Shah et al. [12] who reported 87.4% adult, 10% pediatric and 2.6% geriatric patients respectively.

Severity of anemia: Anemia was a prominent feature and of severe nature in all cases of P. falciparum as compared to P. vivax infection as shown in figure 2. Present study showed 93% cases of anemia during P. falciparum infection. Shah et al. [12] at Ahmedabad found 87.5% and 12.5% anemic patients during P. falciparum and P. vivax infection respectively. In one another study carried out by Jain et al. [13], Indore also showed 56.06% PF and 31.8% PV infection induced anemia respectively.

RBC count: Decreased RBC count in the present study was seen in 83.5% P. falciparum and 50.8% in P. vivax cases respectively. Thus RBC count reduction was strongly associated with P. falciparum infection which was subsequently responsible for severe anemia in patients. Out of the 100 cases studied in the present study 91% had low hematocrit compared to 9% normal hematocrit.

Blood indices: Relationship of PF and PV infection and value variation in MCV, MCH and MCHC is shown in figure 3. Over all there were equal number of patients with normal and low MCV 47.2% and 50.6% respectively. Amongst the two species PV
Fig. 1: Showing species wise trend of malaria between Jul-Dec 2009.

Fig. 2: Severity of anemia in Falciparum & Vivax malaria

had more number of patients with low MCV 57.1%. MCH was predominantly normal in 56.7% cases. 32.2% had low MCH whereas 11.2% had high levels. No species specific difference was noted in values of MCH. MCHC was normal in 61.8%, high in 35.6% and low in 2.6%. High MCHC values were observed in both the species (38.2% and 28.6% respectively). Changes of RDW were seen in 95.7% of cases of the total 100 cases studied.

ESR: In the present study 94.8% cases showed increased ESR, mild rise was seen in 35.2%, moderate rise in 45.3% and severe rise in 14.3% of the total cases respectively. In PF infection markedly raised values were seen in 17.6% cases compared to 6% in PV infection of the total 100% cases.

Reticulocyte count: Out of the total 100 cases, 55.4% cases showed normal RC, 25.7% had high RC and 18.8% had lower RC cases respectively. 29.9% of the patients of PF showed increased RC, whereas 31.3% cases of PV had low RC.

Platelet count: Relationship of platelet count with PF and PV infection is shown in figure 4. Overall 81.5% patients had thrombocytopenia which was mild
Fig. 3: Relationship of MCV, MCH and MCHC between *Falciparum* & *Vivax* malaria

Fig. 4: Relationship of Platelet count with *Falciparum* & *Vivax* malaria

in 26.1%, moderate in 31%, and severe low in 21.3% and profoundly low in 3.1% cases. The percentage and grade of thrombocytopenia were almost equal in both the species. In vivax malaria, mild and moderate degree of thrombocytopenia was more common whereas in falciparum malaria severe thrombocytopenia was more commonly seen. There was significant association between species of malaria and degree of thrombocytopenia.

**Plateletcrit value:** Plateletcrit value was found low in both the species. Only 11.7% patients had normal plateletcrit. Mean platelet volume was normal in 81.4% cases. Low mean platelet volume was noted in 10% and high mean platelet volume in 8.7% of cases. Platelet distribution width was low in all cases of malaria in both the species. Normal PT was seen in 70.7% cases & 29.3% of cases showed high PT. Most of the patients with increased PT had jaundice.

**CONCLUSION**

1. Moderate fall in Hb, moderately raised ESR, mild leukocytosis, moderate to severe thrombocytopenia with low mean platelet volume and platelet distribution width, normocytic hypochromic and normocytic normochromic anemia and the presence of target cells were
the significant hematological abnormalities in both adults and children. Children in addition had decreased reticulocyte counts.

2. Fall in Hb and platelet count while more degree increase in WBC count, ESR and reticulocyte count were noted in patients infected with P. falciparum compared to P. vivax, suggesting that difference in the hematological parameters do exist between the two species.

3. *P. falciparum* was the predominant species detected in the patients of malaria.

4. Anemia, elevated ESR and thrombocytopenia were seen even in low grade parasitemia, simultaneous presence of three findings should prompt a diligent search for the plasmodium parasite.

**Abbreviations used in text and figures:** PF = *P. falciparum*; PV = *P. vivax*; CBC = Complete blood count; MCV = Mean corpuscular volume; MCH = Mean corpuscular hemoglobin; MCHC = Mean corpuscular hemoglobin concentration; RDW = Red cell distribution width; ESR = Erythrocyte sedimentation rate; PT = Prothrombin time; G.I.T = Gastro intestinal tract; RC = Reticulocyte count.

**REFERENCES**