Alteration in biochemical parameters in malaria patients. *Plasmodium falciparum* vs. *Plasmodium vivax*

GURJEET SINGH[1], ANANT DATTATRAYA URHEKAR[1], RAKSHA SINGH[1], UJWALA MAHESHWARI[2], PARINITA SAMANT[3].

[1]Department of Microbiology, Mahatma Gandhi Misson's Medical College and Hospital, Mahatma Gandhi Misson's Institute of Health Sciences (Deemed University), Mumbai, India

[2] Department of Pathology, Mahatma Gandhi Misson's Medical College and Hospital, Mahatma Gandhi Misson's Institute of Health Sciences (Deemed University), Mumbai, India

[3]Department of Biochemistry, Mahatma Gandhi Misson's Medical College and Hospital, Mahatma Gandhi Misson's Institute of Health Sciences (Deemed University), Mumbai, India

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ABSTRACT

Objective: The aim of this study was to investigate the effect of malarial parasites, on different biochemical liver and renal parameters. This was a retrospective and hospital-based study, which was carried out at Department of Microbiology and Central Clinical Laboratory, MGM Medical College and Hospital, Navi Mumbai, is an endemic malaria transmission.

Methods: A total of 60 samples were included in this study out of which 30 samples with peripheral blood film evidence of falciparum malaria and 30 samples of vivax malaria. Liver function tests and renal function tests were estimated by standard method.

Results: *the results showed an increased level in Plasmodium falciparum than Plasmodium vivax which is statistically significant. In our study we found that Plasmodium falciparum altered more biochemical parameters than Plasmodium vivax.*

Conclusions: The biochemical markers can be used as biomarkers for the confirmation of malaria.

KEY WORDS: **Malarial infection, Liver function tests, Renal function tests**

Introduction

Malaria is a major health problem in developing countries accounting for 2-3 million deaths per year. Malaria a tropical protozoan disease transmitted through female *Anopheles* mosquitoes. It is mainly caused by various species of plasmodium parasite [1]. Four species of intracellular protozoa of the genus Plasmodium cause malaria in humans. They include *Plasmodium falciparum*, *P. vivax*, *P. ovale*, and *P. malariae*. *P. falciparum* and *P. vivax* cause the most serious forms of the disease. [2]. Blood is a tissue that circulates in a virtually closed system of blood vessels. It is composed of solid elements-red, white blood cells, and platelets, suspended liquid medium-plasma. Therefore, the plasma is an extracellular fluid confined within the vascular system. The water and electrolyte composition of plasma is particularly the same as that of intracellular fluid, made up of water, electrolytes, metabolites, nutrients, proteins and hormones [3].

Correspondence to: Mr. Gurjeet Singh
Email: : gurjeetsingh360@gmail.com

Physicochemical properties of the blood are constant but may undergo slight variations under normal physiologic conditions. However, the relative constancy in the internal environment of the blood system exhibits wide, profound perturbation and distortions under clinically defined patho-physiologic states. Some of these conditions include malignancy, genetic defects, malnutrition, parasitic infections etc. Studies have revealed that haematologic and biochemical alterations occur in malaria infected blood and there are common complications associated with this disease. Haematologic alterations that are associated with malaria infection include anaemia, thrombocytopenia, and disseminated intravascular [4-7]. Alterations in physicochemical parameters of *P. falciparum* infested blood may vary with levels of malaria endemicity, presence of hae-

moglobinopathies, nutritional status, demographic factors and the level of malaria immunity [8-9]. Therefore, well-informed alterations in blood parameters in malaria infection enable the clinician to establish reliable diagnosis and therapeutic interventions. Malaria pathogenesis is based mainly on extensive changes in biochemical and haematological parameters [10]. The World health Organization (WHO) criteria acknowledged that some biochemical and haematological features should raise the suspicion of severe malaria [11]. Therefore, the present study was undertaken to determine the profile of liver function tests and renal function tests in *Plasmodium falciparum* and *Plasmodium vivax* infected malaria.

Materials and methods

This prospective study was carried out at the Department of Microbiology and Central Biochemistry laboratory, MGM Medical College and Hospital, Navi Mumbai, India, over a period of one year from May 2013 to May 2014. A total of 60 samples were taken (30 *Plasmodium falciparum* and 30 Plasmodium vivax), after confirming by microscopic examination and rapid malarial antigen test, from patients after obtaining written consent. 5 ml blood was collected in EDTA Vaccutainer tube (2.5 ml) and plain tubes (2.5 ml) from each patient using sterile precaution. A thick and thin smear was prepared. Thick smears were dehaemoglobinized and stained with Leishman's stain and focused under 100x oil emersion lens.

Biochemical tests: Patients blood samples were collected in plain tube and keptfor 5-10 minutes for clotting, once the blood samples clot, the blood samples were centrifuged using Laboratory centrifuge R-4C (REMI, India), serum was separated and the tests were applied. Liver function test and renal function test was done using Beckman Coulter-Au480 (USA) by trained technicians under the supervision of a Senior Biochemist.

Statistical analysis

Chi-square test, Z tests and SPSS (version 17) software was used for statistical analysis.

Results

The present study was undertaken to study the effect of malaria on biochemical liver function parameter and renal function. Total of 60 samples were included in this study (30 *P. falciparum* and 30 *P. vivax*). In our study T. Bilirubin, I. Bilirubin, SGOT, SGPT, Urea, Urea nitrogen, Creatinine, Uric acid are statistically significant difference seen in *Plasmodium vivax* and Plasmodium falciparum. *Plasmodium falciparum* affect more than *Plasmodium vivax.*

Table 1. Showing biochemical parameters in *Plasmodium vivax* and *Plasmodium falciparum.*

Tests	Normal Range	*P. vivax* mean ±SD & Range (N=30)	*P. falciparum* mean ±SD & Range (N=30)	P value
T. Bilirubin	0.3 – 1.2 mg/dl	4.3± 3.03 (1.2-18.61)	8.34± 4.03 (1.13-16.29)	0.0001*
D. Bilirubin	0.0 – 0.2 mg/dl	1.2± 1.87 (0.26-9.67)	1.65± 2.22 (0.25 - 8.94)	0.3993
I. Bilirubin	0.3 – 1.0 mg/dl	2.88± 1.98 (1.02-9.94)	4.43± 2.87 (1.01 - 7.35)	0.0180*
SGOT	Upto 35 IU/L	85.1± 49.65 (38.4-226.8)	120.32± 70.26 (35.6 - 261)	0.0288*
SGPT	Upto 35 IU/L	79.69 ± 45.99 (35.7-177)	104.39± 42.66 (36.6 - 154)	0.0358*
Urea	13 – 43 mg/dl	86.51± 14.48 (65 - 80)	111.14± 42.68 (40 - 205)	0.0041*
Urea nitrogen	6 – 20 mg/dl	41.72± 9.48 (20.25-33.64)	59.68± 29.3 (20.11 - 95.79)	0.0023*
Creatinine	0.51 – 0.95 mg/dl	2.1± 0.57 (0.98-2.41)	3.23± 2.9 (0.42 - 10.19)	0.0406*
Uric acid	2.6 – 6 mg/dl	9.58± 1.74 (6.12 - 8.8)	12.03± 3.48 (6.1 - 14.1)	0.0011*

*Statistically significant.

Discussion

The present retrospective study was conducted at Microbiology Department and Central Biochemistry laboratory over a period of one year from January 2014 to December 2014, for to study the alteration in biochemical parameters during malaria by *Plasmodium vivax* and Plasmodium falciparum. In this study we included a total 60 confirmed malaria positive samples, out of which 30 samples were *Plasmodium falciparum*and and 30 samples were *Plasmodium vivax*. In our study we found statistically significant difference between *Plasmodium vivax* and falciparum species effects on liver function tests and renal function tests Table 1. Our study showed that the malarial infection affects more biochemical parameters in *Plasmodium falciparum* than *Plasmodium vivax*. Elnoman NE et al., reported higher level of AST, ALT, total bilirubin and indirect bilirubin, while the level of total protein, albumin and globulin was significantly dropped [13]. A significant positive correlation using Pearson's correlation coefficient, was found between liver enzymes, age, hemoglobin, bilirubin level ($p<0.005$); a negative insignificant correlation with albumin and total protein $p>0.005$. [13] Godse RR reported that there was significant increase in the level of SGOT, SGPT, ALP, bilirubin, creatinine and Urea [14]. Chikezie PC et al., reported serum albumin decreases in malarious subjects whereas serum creatinine concentrations of malarious subjects were increases [15]. Serum urea concentrations of malarious subjects were significantly ($p < 0.05$) higher than the corresponding non-malarious age group. Subjects with moderate malaria infection showed symptoms of anaemia, alterations in nitrogen and carbohydrate metabolism and exemplified by raised serum level of urea. Adeosun OG et al., reported that the urea, creatinine and bilirubin levels were significantly elevated in the acute falciparum malarious children than in the non-parasitaemic controls [16]. Acute falciparum malaria resulted in significant reduction of total protein, albumin and glucose levels in the malarious children [16]. Malaria is a disease which causes high morbidity and mortality in patients. It can be reduced by following the biochemical parameters along with malaria diagnosis. The biochemical parameters may be used as a biomarker to differentiating vivax malaria from falciparum malaria which is severe in mortality. Our study concluded that malaria has a significant impact on biochemical profile therefore it must be considered as a leading differential diagnosis in acute febrile patients with more abnormalities including spleenomegaly and hepatomegaly.

Conflict of Interest

We declare that we have no conflict of interest.

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