

Serum Enzyme Activities in Patients with *vivax* Malaria and *falciparum* Malaria

Mohammad Ali Pir¹, Bikha Ram Devrajani², Saira Baloch^{*2} and Marya Baloch³

¹Department of Community Medicine & Public Health, Liaquat University of Medical & Health Sciences, Jamshoro, Sindh, Pakistan

^{2,*}Medical Research Center, Liaquat University of Medical & Health Sciences, Jamshoro, Sindh, Pakistan

³Institut Sciences Chimiques de Rennes, UMR 6226 CNRS Université de Rennes

*saira_dr01@yahoo.com, *saira.baloch@lumhs.edu.pk

Abstract– Malaria is the most serious tropical diseases in the world and health risk to humans for many generations. Enzyme activity plays vital roles in metabolic pathways are expected to be severely disturbed in malarial patients.

Methods: In the present study, blood serum levels of Enzyme Activities were determined in patients with *vivax malaria* and *falciparum Malaria* as compared to the Healthy Control Subjects. Creatine phosphokinase (CPK), Alkaline phosphatase (AKP), Lactate dehydrogenase (LDH), and Glutamine oxalotransaminase (S-GOT) activity were evaluated Thirty intravenous blood samples each from referred *vivax malarial* and *falciparum malarial* patients and a group of Healthy Control Subjects. The blood samples were centrifuged at 1500 rpm for 20 minutes; the serum was separated and immediately used for the determination of the enzyme activity by kit method using software controlled system on MicroLab300.

Results: The level of Alkaline phosphatase (AlkP), Lactate dehydrogenase (LDH) Creatine phosphokinase (CPK) and serum glutamic oxaloacetic transaminase (SGOT) were increased in *vivax malaria* patients as compared to the control subjects, whereas, in *falciparum malaria* patients Lactate dehydrogenase (LDH) activity observed was increased, Alkaline phosphatase (AlkP), CPK and s-GOT activity were decreased as compared to the control subjects.

Conclusion: The outcome of research is that there is an imbalance in Enzyme activities during the disease which shows the imbalanced metabolic system influenced by *vivax malaria* and *falciparum malaria*. It is concluded that these enzymes can be utilized as marker in specifically for the patients.

Keywords– *Vivax Malaria*, *Falciparum Malaria*, Serum, Enzyme Activity and MicroLab300

I. INTRODUCTION

Malaria is a devastating parasitic disease transmitted by the bite of infected *Anopheles* mosquitoes. Endemic to tropical and subtropical areas of Asia, North and South America, the Middle East, North Africa, and the South Pacific, *Plasmodium vivax* is the most common of four human malaria species (*P. falciparum*, *malariae*, *ovale*, and *vivax*) [1].

Malaria continues to be a major public health problem in Pakistan, both *P. falciparum* and *P. vivax* are found. Estimated number of annual malaria episodes in Pakistan is 1.5 million. Number of confirmed malaria cases reported for last three consecutive years in 2006 there are 124910 cases, in the year 2007 there are 128570 cases whereas in 2008 the reported case are 104454 [2].

Enzymes accelerate biological reactions involved in all chemical transformation reactions in the body. It may even decrease the amount of free energy needed to activate a specific reaction. An enzyme may favor the production of only one product over the others, when more than one product is possible in a reaction [3]-[5].

It is reported that Lactate dehydrogenase activity was determined in the serum patients with acute uncomplicated malaria and a control group of healthy adults. The activity of LDH reported was significantly higher in the patients than the controls. An acute hepatocellular injury and red cell haemolysis induced by the invading merozoites during malaria might cause an increase in serum LDH activity hence, serum LDH activity was potentially valuable enzymatic marker of acute, uncomplicated *P. falciparum* malarial patients, in the absence of other complicating diseases associated with the normal serum LDH activities [6]. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities reported in adult patients with acute, uncomplicated *falciparum* malaria and a control group of adults studied [7] showed significant increased levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities as compared to those of the control group. The serum alkaline phosphatase activity reported in the serum of infected with the *falciparum* malaria adult patients and a control group of healthy adults was significantly increased in patients relative to the normal subjects. The high serum alkaline phosphatase activity in the patients indicated that the liver stage of *falciparum* malaria infection was accompanied by a perturbation of the host hepatocytes drainage pathways where, alkalinephosphatase is localized on the cell membrane of the parasite. Hence, alkaline phosphatase could be an important biomarker for the

assessment of the integrity of the hepatic drainage system in acute falciparum malaria [8]. Skeletal muscle damage is common in malaria. In order to investigate the relationship between serum creatine kinase and myoglobin levels, muscle histology, and renal function in *Plasmodium falciparum* malaria, serum creatine kinase levels were estimated in patients with uncomplicated malaria, with severe non-cerebral malaria, and with cerebral malaria. Mean serum creatine kinase activities estimated increased in patients with uncomplicated malaria, with severe non-cerebral malaria, and with cerebral malaria. Muscle appears to be an important site for *P. falciparum* sequestration, which could contribute to metabolic and renal complications [9].

Very little is known on the metabolic abnormalities in the patients with *vivax malaria* and *falciparum malaria*. Metabolism is related to the activities of different enzymes. In order to investigate the metabolic abnormalities in the patients with *vivax malaria* and *falciparum malaria* enzyme activity in the blood serum of both groups were measured and compared with the healthy control subjects. Thirty intravenous blood samples of confirmed *vivax malaria* patients, *falciparum malaria* and thirty samples of Healthy Control Subjects were taken in the present study. The Enzyme activity were determined using kit method on Microlab 300, the level of Alkaline phosphatase (AlkP), Lactate dehydrogenase (LDH) Creatine phosphokinase (CPK) and serum glutamic oxaloacetic transaminase (SGOT) were determined in *vivax malaria patients* and *falciparum malaria patients* as compared to the control subjects.

II. METHODOLOGY

In this study intravenous blood sample of thirty confirmed *vivax malaria* and *falciparum malaria* patients and healthy control subjects 5ml in each case were obtained separately from, Liaquat University Hospital, Jamshoro, and City Hospital, Hyderabad Sindh, Pakistan. The samples taken in the disposable syringes were transferred in the sample tubes were immediately centrifuged and the serum separated were used for the analysis. The blood samples were analysis of enzyme activity of AlkP, CPK, LDH, and s-GOT, ASAT using kit method on Microlab 300. The kit was obtained from Merck, Germany.

The history and chemical examinations results of the patients of confirmed *vivax malaria* and *falciparum malaria* shows the symptoms of fever and headache, Rigors chills, body aches in and vomiting, splenomegaly, pallor of all cases both in *vivax* and *falciparum malaria*. Additional symptoms including diarrhea less frequently, low blood pressure of 95/60 mm of Hg, and a pulse of 120 beats/min were also seen in these patients. Specifically the patients diagnosed with *vivax malaria* the symptoms with Jaundice, hepatosplenomegaly were admitted in the hospital in which the chemical examination shows decreased level of hemoglobin.

III. RESULTS

Table 1: Enzyme Activity of AKP, CPK, LDH and S-GOT in *vivax malaria* patients and Control Subjects

Variables	Control Subjects	<i>Vivax malaria</i>	p- value
AKP U/L	107.90±9.04	155.57±16.55	0.01
CPK U/L	82.53±5.87	88.37±7.66	0.58
LDH U/L	283.70±9.48	508.90±36.34	0.00
S-GOT U/L	18.53±1.00	42.00±4.70	0.00

From the above data (Table 1) it was observed that the enzyme AKP, LDH and S-GOT activity increases significantly whereas serum levels of CPK increases slightly in *vivax malaria* patients as compared to the control subjects.

Table 2: Enzyme Activity of AKP, CPK, LDH and S-GOT in Control subjects and *falciparum malaria* patients

Variables	Control Subjects	<i>falciparum malaria</i>	p- value
AKP U/L	125.66±8.95	32.95±4.25	0.00
CPK U/L	106.89±8.69	12.00±1.63	0.00
LDH U/L	266.06±15.58	1276.41±147.95	0.00
S-GOT U/L	19.94±0.98	14.34±2.79	0.31

From the above data (Table 2) it was observed that the enzyme AKP, CPK, and S-GOT activity decreases significantly and LDH activity increases significantly in *falciparum malaria* patients as compared to the control subjects.

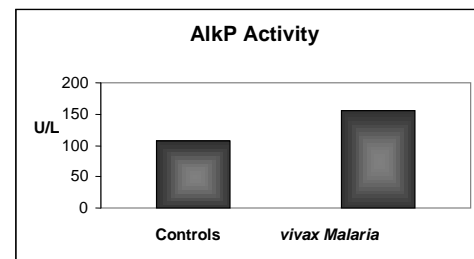


Fig. 1(a): Shows the graphical representation of enzyme AlkP activity in control subjects and in *vivax malaria* patients. The graph represents the serum levels of AlkP activity increases in *vivax malaria* patients as compared to the control subjects

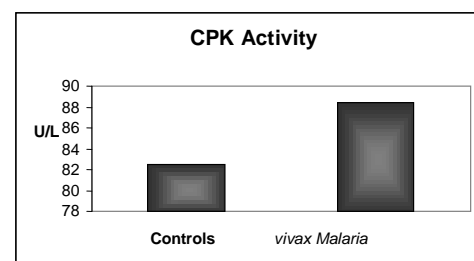


Fig. 1(b): Shows the graphical representation of enzyme CPK activity in control subjects and in *vivax malaria* patients. The graph represents the serum levels of CPK activity increased in *vivax malaria* patients as compared to the control subjects

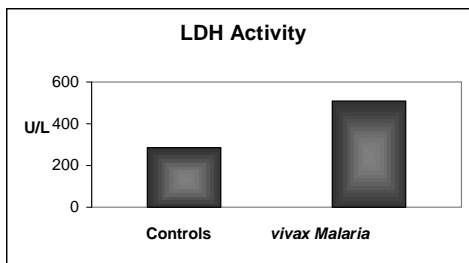


Fig. 1(c): Shows the graphical representation of enzyme LDH activity in control subjects and in *vivax malaria*. The graph represents the serum levels of LDH activity increases in *vivax malaria* patients as compared to the control subjects

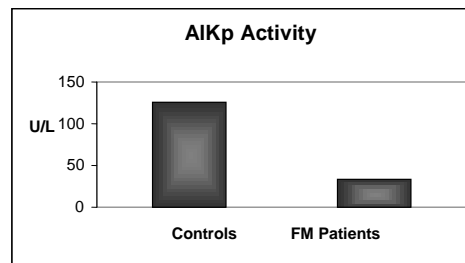


Fig. 2(c): Shows the graphical representation of enzyme AlkP activity in control subjects and in *falciparum malaria* patients. The graph represents that the serum levels of AlkP activity significantly decreased in *falciparum malaria* patients as compared to the control subjects

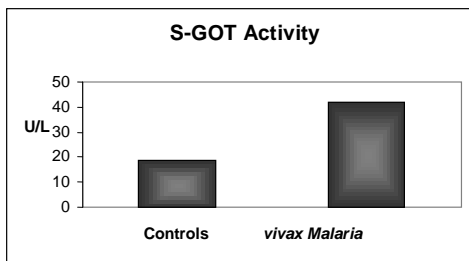


Fig. 1(d): Shows the graphical representation of enzyme S-GOT activity in control subjects and in *vivax malaria*. The graph represents the serum levels of S-GOT activity increased in *vivax malaria* as compared to the control subjects

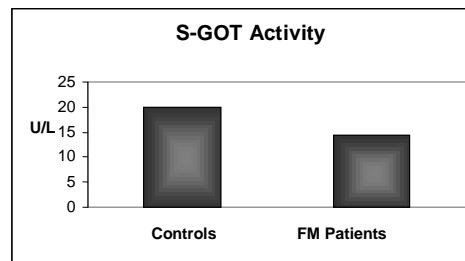


Fig. 2(d): Shows the graphical representation of enzyme S-GOT activity both in control subjects and in *falciparum malaria* patients. The graph represents that the serum levels of S-GOT activity decreased in *falciparum malaria* patients as compared to the control subjects

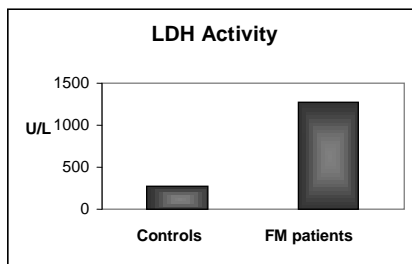


Fig. 2(a): Shows the graphical representation of enzyme LDH activity in control subjects and in *falciparum malaria* patients. The graph represents the serum levels of LDH activity increases significantly in *falciparum malaria* patients as compared to the control subjects

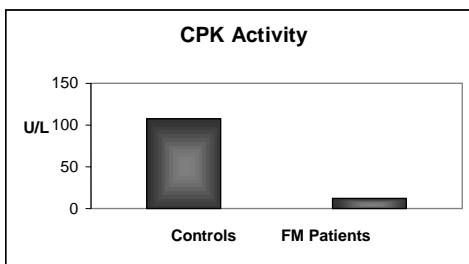


Fig. 2(b): Shows the graphical representation of enzyme CPK activity in control subjects and in *falciparum malaria* patients. The graph represents the serum levels of CPK activity decreased in *falciparum malaria* patients as compared to the control subjects

IV. DISCUSSION

It was observed that enzyme AIKP, LDH and S-GOT activities increased and the level of CPK increased slightly in *vivax patients* as compared to the controls. The blood serum enzyme activity determined for AIKP was 155.57 U/L, LDH was 508.90 U/L, S-GOT was 42.00 U/L and CPK was 88.37 U/L and the control subjects were 107.90 U/L, 283.70 U/L, 18.53 U/L and 82.53 U/L.

It was determined in *falciparum malaria* patients that values of AIKP, CPK, and S-GOT activities decreased and LDH activity increased as compared to the control subjects. The blood serum activities were determined 32.95 U/L for the AIKP, CPK was 12.00 U/L, S-GOT was 14.34 U/L and LDH the activity ranged 1276.41 U/L as compared to the controls subjects 125.66 U/L, 106.89 U/L, 19.94 U/L, and 266.06 U/L.

Due to study of enzyme activity on *vivax malaria* and *falciparum malaria* patients, the comparison between both have been made and it's been found that the activity of AIKP, LDH, and S-GOT significantly increased, while there was no change in activity in CPK in *vivax malaria* patients, whereas reverse in the order in activity for the enzymes. AIKP, CPK and S-GOT in *falciparum malaria* patients the activity significantly decreased. It was reported that hepatic function among eighty children aged less than three years suffered with acute *P. vivax malaria* and SGOT, SGPT and AIKP were high in Children the hepatic dysfunctioning was transitory, as these enzymes reached at their normal levels after 6 weeks of

treatment and the transient derangement of hepatic function was thus a common feature of childhood malaria [10]. It was reported Lactate dehydrogenase (LDH) activity in the sera of seventy six adult male and adult female patients with acute, uncomplicated *P. falciparum* malarial patients and a group of eighty healthy adults with matched age group, which showed elevated serum LDH activity in both male and female patients as compared to control subjects. Serum LDH activity was a potential biomarker in acute *falciparum* malarial patients, in the absence of other complication diseases were associated with the elevated serum LDH activity [11]. A normal LDH level was a marker of normal hemolysis. In present study it was determined that values of LDH may be increased in cerebral malarial patients and malarial patients with abnormal hemolysis. An acute hepatocellular injury and red cell haemolysis induced by the invading merozoites during malaria might cause an increase in serum LDH activity; hence serum LDH activity was potentially valuable enzymatic marker of acute, uncomplicated *P. falciparum* malarial patients, in the absence of other complications diseases associated with the normal serum LDH activities [11].

The enzyme CPK is determined for the rapid buffering and regeneration of ATP from ADP serves as an energy reservoir for the utilize of intracellular energy transportation, it is also related to skeletal muscles, brain, photoreceptors, the decreased level of this enzyme may lead to low energy and immunity in the body, which may damage the human body [12]. The enzyme AIKP was utilized by body as phosphate removing agent, found in liver, bile duct, kidneys, bones and placenta, its decreased level may increase the phosphate levels in the cell, it may be fatal for the patients with low immunity [13].

V. CONCLUSION

The present research on *vivax malaria* and *falciparum malarial* may open new opportunity for the therapeutic treatments for the diseases and pharmaceutical industries may develop and manage the medicines. These results can play a vital role as supplementary research upon *vivax malaria* and *falciparum malarial*, which can open a new door in therapeutic development to cure this disease from the abnormal levels of enzyme activities, which shows the imbalanced metabolic system influenced by *vivax malaria* and *falciparum malaria*. It is concluded that these enzymes can be utilized as marker in specifically for the patients.

ACKNOWLEDGEMENT

We are very thankful to Dr. Murtaza Dayo, Registrar of Medical Unit No# 3 L.U.H. for providing us samples of *vivax malaria* and *falciparum malaria* Patients.

REFERENCES

- [1] World Health Organization. Communicable diseases. WHO Malaria facts and figures. World Health Organization, Europe. 2011.
- [2] <http://www.emro.who.int/rbm/CountryProfiles-pak.htm>
- [3] Bairoch A. The Enzyme database in 2000. *Nucleic Acids Res* 2000; 28 (1): pp. 304-315.
- [4] Grisham, Charles M.; Reginald H. Garrett *Biochemistry*.1999. Philadelphia: Saunders College Publications.
- [5] Smith AL, Oxford dictionary of biochemistry and molecular biology. Oxford University Press.1997.
- [6] I H Garba, G A Ubom. Total serum lactate dehydrogenase activity in acute *Plasmodium falciparum* malaria infection. *Singapore Med J*, 2005; 46(11): 632-634.
- [7] I. H. Garba & U. AST/ALT Ratio in Acute, Uncomplicated Falciparum Malaria Infection: Comparison In Relation To the AST/ALT Ratios in Diseases of the Liver. *The Internet Journal of Tropical Medicine*, Volume 2, Number 2, 2005.
- [8] I. H. Garba & U. Serum Alkaline Phosphatase Activity As A Potential Biomarker For The Integrity Of The Hepatic Drainage System In Acute Falciparum Malaria Infection. *The Internet Journal of Infectious Diseases*, Volume 4, Number 2, 2005.
- [9] Davis TM, Pongponratan E, Supanaranond W, Pukrittayakamee S, Helliwell T, Holloway P, White NJ. Skeletal muscle involvement in falciparum malaria: biochemical and ultrastructural study. *Clin Infect Dis*. 1999; 29(4):831-5.
- [10] Dhanpat Kumar Kochar, Gajanand Singh Tanwar, Poonam Chand Khatri and Ashish Das. Clinical Features of Children Hospitalized with Malaria A Study from Bikaner, Northwest India. *Am J Trop Med Hyg* 2010; 83: pp. 981-989.
- [11] I. H. Garba, G. A. Ubom. Total serum lactate dehydrogenase activity in acute *Plasmodium falciparum* malaria infection. *Singapore Med J*, 46 (11), 2005.
- [12] http://en.wikipedia.org/wiki/Creatine_kinase
- [13] http://en.wikipedia.org/wiki/Alkaline_phosphatase