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Original Research Article

Study of serum lipid profile in *Plasmodium falciparum* malaria

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ABSTRACT

Background: Malaria is a major public health problem in India with wide-ranging haematological and biochemical alterations. *Plasmodium falciparum (P. falciparum)* is one of four distinct species of the malaria parasite that afflict humans and pose a threat to public health. Under normal physiological conditions, liver ensures homeostasis of lipid and lipoprotein metabolism. Therefore, the aim of this study was to assess malaria infection and its association with lipid parameters changes. Hepatocellular damage often associated with severe and acute *P. falciparum* infections impairs these processes, leading to alteration in plasma lipid profile and lipoprotein patterns. An observation on the nature of dyslipidaemia in confirmed cases of *P. falciparum* malaria patients with reference to correlation if any that exists between malaria and lipid profile in these patients was performed.
Methods: A case-control study was carried out on clinically and laboratory confirmed *P. falciparum* malaria positive patients attending the outpatient and inpatient department of RIMS Ranchi for a period of six months i.e. from January 2018 to June 2018, 100 participants were enrolled for the present study. 50 participants were *P. falciparum* malaria confirmed cases and 50 participants were without any clinical or laboratory evidence of malaria served as the control.
Results: It revealed that the total cholesterol, HDL and LDL were significantly decreased -($P \leq 0.05$) while triglyceride and VLDL were not significantly changed in *P. falciparum* malaria patients ($P \geq 0.05$).
Conclusions: It can be concluded that alteration in lipid profile can be an index of severe malaria infection that may leads to poor prognosis, but specificity of malaria infection with lipid changes is questionable and need further studies.

Keywords: Lipid profile, Malaria, *Plasmodium falciparum*

INTRODUCTION

Malaria is a disease in humans caused by parasitic protozoan of the genus Plasmodium and it is a severe public health problem in most countries of the tropics and subtropics.[1] In the south-east Asian Region of WHO, out of about 1.4 billion people living in 11 countries (land area 8,466,600 km^2, i.e. 6% of global area), 1.2 billion are exposed to the risk of malaria and most of whom live in India (Kondrachine, 1992).[2]

India is a vast country with multiethnic society of 1.2 billion living in diverse geo-ecological paradigms and ecotype of malaria. Malaria continues to be one of the major public health problems of India with around 1.5-2 million confirmed cases/year, of which approximately 1000 reported malarial death per year.[3] As per World Health Organization report 2011-2012, South-east Asia region bear the second largest burden of malaria (13%), only being next to African region (81%).

Among South-east Asia region, India shares two thirds of the burden (66%) followed by Myanmar (18%) and Indonesia (10%).[4] Sub-Saharan Africa was the most affected region and it was among the ten leading causes of inpatient deaths in children and pregnant mothers, in India

it is the middle productive ages in both genders that suffer the most.[5,6]

Malaria parasites utilize cholesterol and phospholipids for survival in their human host.[7] For these parasites, circulating high-density lipoprotein (HDL) particles and erythrocytic membrane are the potential sources of cholesterol, whereas the source of phospholipids is erythrocytic membrane.[8] Most plasma apolipoproteins, endogenous lipids, and lipoproteins have their origin in the liver, which depends on cellular integrity and functionality of the hepatocytes.[4]

The major lipid component lipoproteins in plasma are chylomicrons, very low-density lipoproteins (VLDL), low-density lipoprotein (LDL), HDL, and free fatty acids. So far, studies suggest that there may be some factors or enzymes, which allow the parasite to breakup and consume lipid/cholesterol from their host and utilize them for internalization of eukaryotic protozoa or for reproduction in case of helminthes.[9] Plasmodium is incapable of de novo synthesis of fatty acids and cholesterol; but it can fabricate its glycerides and phosphoglycerides with host-supplied nutrients, and can produce the glyceryl moiety during glycolysis.[10]

In view of the incidence of malaria in state like Jharkhand which is endemic zone for malaria where large populations is migrant workers and indulge in construction activities in cities, and farming, the present study was undertaken to find out any correlations between the changes in lipid profile of malaria patients.

METHODS

The study was carried out on clinically confirmed *P. falciparum* malaria positive patients attending the outpatient and inpatient department of RIMS Ranchi for a period of six months i.e. from January 2018 to June 2018 which was preapproved by the Ethical Committee of this institution review board. 100 participants were enrolled for the present study. Fifty participants were *P. falciparum* malaria confirmed cases and 50 participants were without any clinical or laboratory evidence of malaria served as the control. The informed consent was obtained from the patients before enrolling them for case-control study. The present study is case-control study. 100 participants were enrolled for the present study.

Fifty patients with clinically and laboratory confirmed *P. falciparum* positive frank malaria will be selected for the study during the study period and 50 participants were without any clinical or laboratory evidence of malaria served as the control.

Inclusion criteria

Study group

- Plasmodium falciparum positive patients
- Both male and female
- Age between 18-50 years in male and female.

Control group

- No evidence of malaria
- Apparently healthy
- Age between 18-50 both male and female.

Exclusion criteria

- Patients who are diabetic, hypertensive, renal diseases, liver disease, hypothyroid and any condition suspected to affect serum lipid profile will be excluded from the study
- Patient will be participants who presented with fasting less than 12 hours before collect of blood sample.

Serum sample will be collected and stored at 50^0C in the presence of EDTA, anti coagulant, and values will be read at wavelength of 500nm. Total cholesterol, fraction will be determined by the enzymatic colorimetric method described by Allain et al. The determination of triglyceride fraction carried out by technique of Bucolo et al. The determination of LDL and VLDL will carried out by salt fractionation technique. The HDL fraction will be isolated from other lipoprotein by heparin manganese chloride precipitation method. Thick and thin film will be made using anticoagulant (EDTA).

Venous blood will be employed in detection of malaria parasites Lipid profile of all participants was estimated by enzymatic method at day 0 (pre-treatment).[11,12] Other routine investigation was also done. Data obtained were statistically analyzed using independent T test, assuming $p < 0.05$ as significant.

RESULTS

Table 1 shows that mean total cholesterol decreased from 1.7180E2±49.47 to 1.1708E2±28.23 in malaria patients from controls ($p < 0.05$), similarly HDL and LDL also decreased in malarial patients from 47.7660±14.13 and 85.3360±36.07 to 26.6640±11.07 and 50.1120±25.29 respectively ($p < 0.05$). But, there were no significant difference in total triglyceride and VLDL noted in malaria patients i.e. from 1.9370E2±121.11 and 38.7400±24.22 to 1.8270E2±83.45 and 34.9760±17.90 respectively ($p > 0.05$). The 'P' value shows difference in significance in different lipid parameter; the unequal significance may be due to small sample size.

DISCUSSION

Malaria is a disease in humans caused by parasitic protozoan of the genus Plasmodium and it is a severe public health problem in most countries of the tropics and subtropics.[1] Malaria causes a major public health problem in people living in the highly affected areas of India

(Eastern states - Jharkhand, Orissa, West Bengal; Central states of Chhattisgarh, Madhy Pradesh; Western states- Gujarat, Karnataka; and North state- Rajasthan). Evidences suggested that lipid parameters are altered in malaria-infected patients. This study included data on 50 confirmed malaria (*P. falciparum*) subjects and 50 healthy controls. The study observed alteration in lipid profile of *P. falciparum* malaria positive subjects compare to the controls. There were no significant difference in triglyceride and VLDL in malaria confirmed subjects but LDL, HDL and Total cholesterol significantly decreased ($p<0.05$).

Table 1: Incidence of different types of asterion.

Lipid types	N=50 (Cases), N=50 (Control)	Mean ± SD	T test	df	P- value
Total cholesterol	Cases	1.1708E2±28.23	-6.792	98	0.000*
	Controls	1.7180E2±49.47	-6.792	77.851	
Total triglycerids	Cases	1.8270E2±83.45	-0.529	98	0.598
	Controls	1.9370E2±121.11	-0.529	86.969	
Total VLDL	Cases	34.9760±17.90	-0.884	98	0.379
	Controls	38.7400±24.22	-0.884	90.225	
Total HDL	Cases	26.6640±11.07	-8.312	98	0.000*
	Controls	47.7660±14.13	-8.312	92.698	
Total LDL	Cases	50.1120±25.29	-5.653	98	0.000*
	Controls	85.3360±36.07	-5.653	87.797	

Results are presented as mean±standard deviation. SD= Standard deviation, E2= Exponential2= 102, df = degree freedom , *=Significant value ($p <0.05$) .

Relationship between serum cholesterol levels in man/animals and parasitic infections has drawn the attention of several authors (Mohanty et al, Bansal et al, Adekunle et al, Liberopoulos et al, Durgut et al18).[9,13-16]

In the present study, the serum levels of TC, HDL, and LDL cholesterols in *P. falciparum* malaria-infected patients were lower than controls. This finding is in contrast to data reported in other studies that showed elevated levels of lipoproteins in patients suffering from malaria infection.[17-20] On the contrary, a study reported that hyperlipidemia is one of the indicators of malaria infection; the hypothesis for the changes is basically due to increased VLDL production and increased mobilization of free fatty acids from adipose tissue in response to stress.[21] However, the evidence of higher concentrations of serum lipids in the infected group might be due to adipose tissue lipolysis, impairment in lipoprotein lipase system, increases in de novo hepatic fatty acid synthesis, and suppression of fatty acid oxidation in severe infection.[9] The decrease in serum TC and LDL cholesterol of malaria patients when compared with normal individuals has been reported by other studies that found no significant change in plasma cholesterol during and after malaria infection.[22,23] Mohanty et al, had earlier posited that serum level of TC is reduced in low-level malarial infection, which is in concord with the present report.[13]

Present study findings of reduction in cholesterol levels in malarial infection added support to earlier reports where hypocholesterolemia was strongly associated with malaria.[22,24,25] A systematic review and meta-analysis in agreement with our study reported that TC, HDL and LDL concentrations were lower in *P. falciparum* malaria patients as compared to healthy controls ($p <0.05$).[26] The decline was more pronounced and statistically significant during malaria compared to other febrile diseases but TG and VLDL levels showed no significant difference compared to healthy controls ($p >0.05$).

Marked decline in HDL has been seen in malaria patients, which is similar to another study of Faucher et al, as they reported that malaria infection produces moderate changes in plasma lipid profile in man, with typical decline in HDL concentration.[6] It is worthwhile to note that Ogbodo et al, posited that oxidative modification of HDL and reduced serum levels of this class of lipoprotein was associated with the pathophysiology of malaria.[27]

Dyslipoprotinemia does occur in patients having active infections with most of the parasites e.g. leishmaniasis, toxoplasmosis, helminths. Membrane proteins are probably involved in such reactions.[9] Changes in lipid levels may not be unique to malaria infection. Another study, found striking elevation of total serum lipids in gram-negative bacilli infection while patients with severe gram positive cocci infection had normal serum lipids.[28] A possibility of a correlation between plasma cholesterol levels and the acute phase response during sepsis, burns, critical illness, etc has also been established.[29,30] The changes in the level of plasma lipoprotein may be attributed as a part of an acute phase reaction.[31,32] Hence a question raises regarding the specificity of lipid changes with malaria infection.

CONCLUSION

Authors have observed that parameters of lipid profile in *P. falciparum* malaria infected patients significantly differ from that of healthy controls. Thus, a relation can be established between lipid profile and malaria infection. It can be concluded that alteration in lipid profile can be an index of severe malaria infection that may leads to poor prognosis, but specificity of malaria infection with lipid changes is questionable and need further studies.

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