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**Original Research Article**

# Lipid profiles among *Plasmodium falciparum* infected, non malarial febrile patients and volunteers

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## ABSTRACT

**Background:** Acute falciparum Malaria infected patients show wide ranges of metabolic derangement including changes in serum lipid profiles. The exact mechanisms of this derangement in serum lipid profiles are still poorly understood. Objective was to study the lipid profiles among acute plasmodium falciparum infected patients.
**Methods:** It was a Prospective observational comparative study. A total of 100 patients were consecutively taken in the study. Fifty Non- malaria febrile cases and 50 healthy volunteers were taken as control group. Baseline lipid profiles were estimated in all cases at the time of admission and at the end of one week. Data were collected and analyzed.
**Results:** There were 100 diagnosed cases of falciparum malaria and 50 non malarial febrile and 50 healthy volunteers taken as control group. Complications was present in 50 and 50 were uncomplicated. Serum total cholesterol, HDL and LDL levels were significantly low in falciparum malaria patients, and serum TG and VLDL levels were higher than control. There were no significant changes in mean serum lipids profiles in survived and deaths cases.
**Conclusions:** The derangement in lipid profiles in falciparum malaria was characteristic and specific for the disease. Characteristic changes were lower HDL, LDL and total cholesterol levels and higher TG and VLDL levels in comparison to control groups. Changes are more pronounced in complicated falciparum Malaria and persisting till the end of the week. These findings may be of diagnostic and prognostic value.

**Keywords:** Acute *Plasmodium falciparum*, Malaria infection, Lipid profiles

## INTRODUCTION

Patients with malarial infection show the wide range of metabolic derangements including changes in serum lipid profile. These changes in serum lipid profile and their possible correlation with malarial infection has been reported in various studies.[1] The exact mechanisms resulting in these derangements in serum lipid profile in patient infected with the Malaria parasite is still poorly understood. Under normal physiological conditions liver ensures homeostasis of lipid and lipoprotein metabolism.[2] Hepatocellular damages often associated with severe and acute Plasmodium falciparum (pf) malaria infections impair this process leading to alteration in plasma lipid and lipoprotein patterns. Parasites forge nutrients from their hosts as well as possess limited enzyme pathway for de novo synthesis of certain nutrients. So far studies suggest that there may be some factors or enzyme which allows the parasites to break up and consume lipids/cholesterol from their host and utilize them for internalization of Eukaryotic protozoa.[3]

Plasmodium is incapable of de novo synthesis of fatty acids and cholesterol. Haeme it is toxic to the malaria parasite and it is detoxified by lipid mediated crystallization to biological inert hemozoin. Also lipid

content of parasites and liquid form haemolysed RBC membrane could alter serum lipid level.[4] All these factors combined may be responsible for lipid derangements.

Changes in serum lipid profile are seen in many other conditions including post surgical burn injury, Malignancy, Acute myocardial infarction and with many other parasitic infections, including leishmaniasis, toxoplasmosis and helminthes.[5-8] With such diverse causes of lipid derangements the, question arises as to whether these serum lipid changes are specific for malarial infection or are simply part of an acute phase reaction?

This study was therefore intending to study the effect of Pf. Malarial infection on serum lipid profile and their characteristic pattern of derangements specific to infection induced by Pf. Malarial. It may help in diagnosis, correlation with severity and in predicting outcome of disease.[2,3]

Objective was to study the lipid profiles among acute plasmodium falciparum infected patients.

## METHODS

The Present study was undertaken in the department of medicine at VSSIMSAR, Burla during the period October 2015 to October 2017 after approval of institutional ethics committee. This was a prospective observational and comparative study of 100 consecutively diagnosed *Plasmodium falciparum* Malaria cases and there were 50 non malarial febrile patents and 50 healthy volunteers were taken for control.

Malaria patient along with pregnancy, obesity, metabolic syndrome, alcoholism, smoking, previously documented dyslipidemia, Diabetes mellitus, Hypertension, Hypothyroidism, chronic liver diseases, Nephrotic syndrome, CKD, H/O drug intake like oral contraceptive pills, steroid, statins, age ≥ 45 years etc. were excluded from the study. Diagnosis of Malaria was done by clinically and confirmed by thick and thin film, MP-QBC, MP-ICT, and other relevant investigations were done as needed.

All samples for lipid profiles test were taken in di-potassium ethylene tetracetic acid (K2EDTA) tubes and stored at 50C until required for analysis. Samples for Lipid profile test was taken on day of admission and repeated after 7 days in all cases. The samples were obtained after a 12-hour fasting period for all volunteers. The value of LDLc was calculated based on Friedewald's equation: LDL (mg/dl) = Total cholesterol – (TG/5+HDLC). VLDL was calculated according to equation VLDL (mg/dl) = Serum TG/5. Data were collected, and descriptive analysis was done and for continuous data, t-Test was used to compare study and control groups. A P- value of <0.05 was considered statistically significant.

## RESULTS

This study was concluded on 100 laboratory confirmed cases of pf malaria patients of both complicated and uncomplicated. There were 50 healthy volunteers and 50 non-malarial febrile cases taken as control group. The ages of patients were between 15 to 29 years. Maximum patients were in age group 15-29 years (56%).

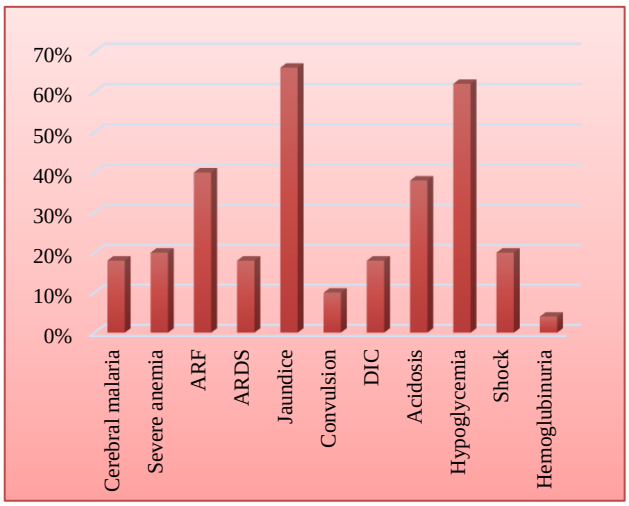


**Figure 1: Clinical profiles of complications in pf. malaria cases.**

In Figure 1, this study jaundice was present in highest number in complicated malaria cases 33(66%), renal failure in 50%, acidosis in 38%, anaemia in 40%, Cerebral Malaria 18%, ARDS in 18%, convulsion in 10%, DIC in 18%, Shock in 20%, haemoglobinuria in 4% and multi organ failure in 50% case.

**Table 1: Mean serum lipid in Falciparum malaria infected patients versus non malarial febrile patients and volunteers.**

| Mean serum lipids | F. malaria (n=100) | | Control (n=100) | | Significance |
|---|---|---|---|---|---|
| In mg/dl | Mean | SD | Mean | SD | P-value |
| Total cholesterol | 151 | 12.83 | 182.64 | 12.08 | <0.05 |
| HDL | 29.39 | 5.66 | 40.4 | 3.29 | <0.05 |
| LDL | 74.03 | 12.47 | 112.1 | 12.34 | <0.05 |
| VLDL | 47.57 | 3.29 | 30.13 | 1.4 | <0.05 |
| TG | 237.86 | 16.45 | 150.69 | 7.01 | <0.05 |

Table 1 showing the mean value for total cholesterol, HDL and LDL was significantly lower in case group 150±12.83 mg/dl, 29.39±5.66 mg/dl and 74.03±12.47 mg/dl respectively then in control group of 182.64±12.08 mg/dl, 40.4±12.47 and 112.1±12.34 mg/dl respectively. But, serum triglyceride and VLDL were significantly higher in case group (237.86±16.45 ml/dl) and 237.86±18.45 mg/dl respectively than in control group

(150.69±7.01 ml/dl) and 30.13±1.4 mg/dl respectively (P <0.05).

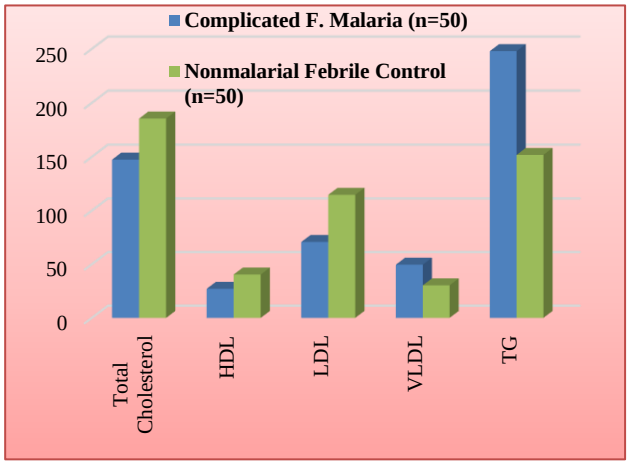


**Figure 2: Mean lipids profiles in complicated and non malarial febrile cases.**

Figure 2 showing that total cholesterol and LDL was significantly lower in falciparum malaria infected patients than in non malarial febrile control. VLDL and TG is significantly higher in malaria than in control group (P <0.05).

**Table 2: Mean serum lipids in complicated pf. malaria versus uncomplicated pf. malaria.**

| Serum Lipids | Complicated malaria (n=50) | | Uncomplicated malaria (n=50) | | |
|---|---|---|---|---|---|
| In mg/dl | Mean | SD | Mean | SD | P-value |
| Total cholesterol | 147.38 | 16.32 | 154.62 | 6.03 | <0.05 |
| HDL | 27.06 | 6.34 | 31.72 | 3.6 | <0.05 |
| LDL | 70.74 | 14.89 | 77.33 | 8.24 | <0.05 |
| VLDL | 49.58 | 3.02 | 45.56 | 2.1 | <0.05 |
| TG | 247.9 | 15.14 | 227.82 | 10.51 | <0.05 |

Table 2 shows the total cholesterol, HDL and LDL levels where lower in complicated Malaria than in uncomplicated Malaria (P < 0.05). Serum TG and VLDL were higher in complicated falciparum Malaria group then uncomplicated Malaria group (P <0.05).

**Table 3: Comparison of mean serum lipids in falciparum malaria on day of admission versus on 7th day there was no significant difference.**

| Mean serum lipids | ON day of admission | | On 7th day | | Significance |
|---|---|---|---|---|---|
| In mg/dl | Mean | SD | Mean | SD | P-value |
| Total cholesterol | 151 | 12.83 | 152.54 | 12.52 | >0.05 |
| HDL | 29.39 | 5.66 | 30.61 | 5.19 | >0.05 |
| LDL | 74.03 | 12.47 | 76.01 | 11.37 | >0.05 |
| VLDL | 47.57 | 3.29 | 45.91 | 3.69 | >0.05 |
| TG | 237.86 | 16.45 | 229.58 | 18.49 | >0.05 |

**Table 4: Serum lipid values on day of admission vs on 7th day in falciparum malaria, no changes, except serum TG levels decreasing on 7th day in uncomplicated falciparum malaria only.**

| | On Day of Admission | | On 7th day | | Significance |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | P-value |
| Total Cholesterol | 154.62 | 6.03 | 156.96 | 6.46 | >0.05 |
| HDL | 31.72 | 3.6 | 33.16 | 3.68 | >0.05 |
| LDL | 77.33 | 8.24 | 80.52 | 6.38 | >0.05 |
| VLDL | 45.56 | 2.1 | 43.28 | 3.48 | >0.05 |
| TG | 227.82 | 10.51 | 216.4 | 17.4 | <0.05 |

**Table 5: No correlation of serum lipids in survived vs deaths in patients of complicated falciparum malaria cases.**

| Serum Lipids | Survived | | Death | | Significance |
|---|---|---|---|---|---|
| In mg/dl | Mean | SD | Mean | SD | p-value |
| Total Cholesterol | 148.26 | 17.34 | 143.33 | 7.21 | >0.05 |
| HDL | 27.39 | 6.52 | 25.55 | 4.49 | >0.05 |
| LDL | 71.29 | 15.41 | 68.22 | 10.15 | >0.05 |
| VLDL | 49.58 | 3.23 | 49.55 | 1.42 | >0.05 |
| TG | 247.92 | 16.15 | 247.77 | 7.13 | >0.05 |

Table 3 shows there was no significant difference in serum lipids on 1st day of admission and 7thday. Total mean serum cholesterol, HDL and LDL values were lower in comparison to control group, but the difference was insignificant between day of admission and on 7thday in malaria cases.

Table 4 shows there was no significant changes in different serum lipid values found from day of admission to 7th day, except serum TG level which is decreasing towards 7th day in uncomplicated falciparum malaria compared to complicated malaria.

Table 5 shows no significant correlation in mean serum lipids between survived and death cases of complicated pf. malaria patients.

## DISCUSSION

The results of this study was comparable to other studies of lower levels of total cholesterol, HDL and LDL and higher levels of TG and VLDL in acute phase of pf.malaria in comparison to normal volunteers. Benjamin J et al in their study found that serum lipid levels (mmol/l) were significantly lower in malaria patients compared with those with other febrile diseases.[9] In present study mean value for total cholesterol was significantly lower in pf .malaria (151±12.83mg/dl) than in control group (182.64±12.08mg/dl) P-Value <0.05. Similarly serum HDL is significantly lower in pf malaria 29.39±5.66 mg/dl than in control group 40.4±3.29 mg/dl (P <0.05). Similarly serum LDL is significantly lower in pf. malaria (74.03±12.47 mg/dl) than in control group 112.1±12.34mg/dl (P <0.05). But serum Triglyceride was significantly higher pf malaria (237.86±16.45 mg/dl) than in control group 150.69±7.01 mg/dl (P <0.05). VLDL was higher in pf. malaria than in control group (P<0.05).

Aknabi OM et al found that in malaria infection serum LDL was increased.[10] Present study along with study of Benjamin et al does not agree with this finding.[9] Visser et al in his Meta analysis, total cholesterol, HDL and LDL concentration were lower in malaria and other febrile illness compared to healthy controls.[11] TG were raised compared to healthy controls but not statistically significant when compared to symptomatic control. But in our study TG is significantly higher in pf malaria 227.82±10.51mg/dl than in non malarial febrile controls 51.74±6.66 mg/dl (P< 0.05).

In this study total cholesterol was significantly lower in complicated pf. Malaria than in non- malarial febrile control group. HDL was also lower in complicated pf. malaria than in non- malarial febrile controls. LDL was also lower in complicate pf. malaria than in non- malaria febrile controls. VLDL and TG were significantly higher in complicated pf. malaria than in non malarial febrile control.

In comparing serum lipids in complicated Malaria with uncomplicated malaria we found that total cholesterol, HDL and LDL levels were lower in complicated Malaria than in uncomplicated malaria (P <0.05). Serum TG and VLDL levels were higher in complicated pf. malaria than in uncomplicated group (P<0.05). Benjamin J et al found that these result were consistent across their studies.[9] TG were raised in complicated than in healthy controls, but not statistically significant when compared to symptomatic control. As there was no significant difference in serum lipid between in healthy volunteers and non malarial febrile controls it is postulated that the changes in lipid profile in pf. malaria infection is not only due to acute-phase reaction but also due to other mechanism playing a role in it. There is no significant difference in serum lipids between day of admission and 7th day.

In present study authors had taken a different control group of non malarial febrile controls and healthy volunteers to prove that these changes were specific to malaria infection. In complicated malaria and uncomplicated malaria patients no significant changes in different serum liquid values are found from day of admission to 7th day, except for TG in which the difference was significant in serum TG level and was decreased towards 7th day in uncomplicated pf. malaria, where as it was persisted up to ≥7 days. Jacob EA reported similar results to ours and the mean pre-treatment values of TC was 96.88±19.81 mg/dl, TG of 22.02±1.55, LDL of 17.72±1.25MG/dl, HDL of 28.75±6.51mg/dl in 202 cases of pf malaria and in 102 cases of healthy control cases TC of124.03±10.29mg/dl, TG of 11.63±1.15mg/dl, LDL of 6.89±0.68mg/dl and HDL of 42.08±3.66mg/dl respectively.[12]

Warjri SB et al reported a similar study whose results was in concordance with our result but they have taken only in clinical malaria in their study group and normal volunteers as control, where as we have taken confirmed malaria cases in study group and non-malarial febrile cases and normal volunteers as control to confirm the specific effect of pf. malaria on lipid profiles in acute stage of falciparum malaria.[13]

## CONCLUSION

Pf. Malaria infection in acute stages associates with characteristic pattern of lipid derangement. It includes lower level of HDL, LDLand total cholesterol and higher levels of TG and VLDL. Where as Non malarial febrile patients had higher levels of HDL, LDL, and total cholesterol. Total cholesterol, HDL and LDL levels were lower in complicated than in uncomplicated pf. malaria and TG and VLDL levels were higher. There was no significant difference in serum lipids between day of admission and 7th day. Lipid profiles can be taken as valuable parameter along with other conventional investigations to differentiate malaria infection from others febrile conditions. It may have prognostic

implications. Further large numbers of studies are warranted.

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