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**Original Research Article**

# A study of variation in serum lipid levels in patients with *Plasmodium vivax* malaria

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## ABSTRACT

**Background:** Malaria is a common protozoal infection. Plasmodium vivax malaria is the most common species distributed worldwide and in India. The vivax malarial infection is associated with various haematological and biochemical abnormalities, anaemia and thrombocytopenia among the frequently identified abnormal parameters. However, vivax malaria is also associated with abnormal lipid levels including low cholesterol levels and normal to high serum triglyceride levels.
**Methods:** This study is a cross-sectional observational study including 100 in patients admitted to Medical College Hospital over a period of 18 months diagnosed with *Plasmodium vivax* malaria. The patients were selected based on inclusion and exclusion criteria. The relevant data was collected and analysed.
**Results:** Vivax malaria infection was found to be more common among males (80%) and during third decade of life (51%). HDL Cholesterol was decreased in all cases, LDL Cholesterol and Total Cholesterol was also decreased in nearly all patients with only 1% cases having values above normal range. Serum Triglycerides was elevated more than 150 mg/dl in 69% cases with 25% cases having values above 200mg/dl. The hypocholestrolemia and hypertriglyceridemia were directly proportional to the thrombocytopenia, hyperbilirubinemia, elevated serum creatinine levels and parasite load.
**Conclusions:** This study demonstrates the presence of altered serum lipid levels in the form of hypocholesterolemia and hypertriglyceridemia in cases of *Plasmodium vivax* malaria mono infection. This study also shows that the above lipid alterations were found to be deranged to greater extent in clinically, haematologically and biochemically severe form of infections.

**Keywords:** Hypocholesterolemia, Hypertriglyceridemia, *Plasmodium vivax* malaria

## INTRODUCTION

Malaria is a protozoal disease caused by infection with parasites of the genus Plasmodium and transmitted to humans by certain species of infected female Anopheline mosquito. Four species of the Plasmodium cause nearly all malarial infections in humans. These are Plasmodium falciparum, *Plasmodium vivax*, *Plasmodium ovale* and *Plasmodium malariae*. *Plasmodium knowlesi*, a fifth species previously confined to monkeys, is now implicated in human disease.[1]

*Plasmodium vivax* is the most widely distributed species worldwide and in India, it is associated with various haematological and biochemical abnormalities. Anaemia, thrombocytopenia, leucopenia, hyperbilirubinemia and azotemia are commonly observed abnormalities. However, the alterations in blood lipid levels in cases of

vivax malaria in a geographyically malaria dense south Karnataka is seldom studied. Hence this study is an attempt to study the lipid changes that occur in association with vivax malaria and its possible associations with other clinical and blood parameters.

## METHODS

This is a descriptive study which include inpatients of Medical College Hospital diagnosed with isolated *Plasmoium vivax* malaria.

A Sample size of 100 was selected for the study using purposive sampling technique based on inclusion and exclusion criteria. Vivax malaria is confirmed by microscopic detection of blood smear for malarial parasite and by malarial parasite fluorescent test. Venous blood samples from patients with isolated *Plasmodium vivax* malaria was collected soon after admission and before initiation of treatment and serum lipid levels were assessed by Enzymatic-Colorimetric method. Venous blood sample was also collected from patients for random blood sugar, total bilirubin, liver enzymes, platelet count and serum creatinine.

### *Inclusion criteria*

- Patients diagnosed as isolated *Plasmodium vivax* malaria by malarial parasite smear test and malarial parasite fluorescent test.
- Patients of 14 to 40 years of age.

### *Exclusion criteria*

Patients with

- Diabetes mellitus
- Liver diseases
- Chronic kidney disease
- Alcohol dependence
- Pregnancy
- Antimalarial treatment started prior to admission
- Drug therapy on - lipid lowering agents
  - Oral contraceptive agents
  - steroids
  - thiazides
  - anticoagulants
- Coinfection with plasmodium falciparum
- Hypothyroidism.

### *Data analysis*

Data collected will be analysed by frequency, percentage and mean.

## RESULTS

This study was conducted on 100 inpatients of a Medical College Hospital admitted with clinical features of acute febrile illness and haematological tests confirmative of *Plasmodium vivax* malaria. Data was collected and the following results were obtained from the study.

Table 1 denotes that the predominant age group of patients with malaria in this study was between 20 to 30 years of age and the mean age was 28.22 years. Table 2 shows that the cases predominantly comprised of male population contributing 80% of the cases.

**Table 1: Age distribution of the cases.**

| Age group | No. of patients | Percentage |
|---|---|---|
| <20 | 20 | 20 |
| 21-30 | 51 | 51 |
| 31-40 | 29 | 29 |

**Table 2: Sex distribution of cases.**

| Gender | No. of patients | Percentage |
|---|---|---|
| Male | 80 | 80 |
| Female | 20 | 20 |

### *Distribution of severity of malaria cases based on parasite load*

Table 3 depicts the parasite load, wherein 1+ was considered as mild cases and 4+ was considered as severe cases in terms of parasite load. In the study most cases were 2+ with occurrence of 50% and the incidence of severe cases was 6%.

**Table 3: Distribution of parasite load.**

| MPFT | No. of patients | Percentage |
|---|---|---|
| 1+ | 12 | 12 |
| 2+ | 50 | 50 |
| 3+ | 32 | 32 |
| 4+ | 6 | 6 |
| Total | 100 | 100 |

**Table 4: HDLc levels in cases.**

| HDL c(mg/dl) | No. of patients | Percentage |
|---|---|---|
| <5 | 8 | 8 |
| 5-20 | 56 | 56 |
| 21-35 | 29 | 29 |
| 36-45 | 7 | 7 |
| Total | 100 | 100 |

### *HDL cholesterol levels*

Table 4 shows that most patients had significant decline HDL cholesterol levels in all the sample cases. All patients had low levels of HDL levels, with 56 % cases having serum HDL between 5 to mg/dl and 8 % cases having levels below 5 mg/dl. The mean HDL cholesterol level was 17.89 mg/dl

***LDL cholesterol levels***

Table 5 shows that almost all the cases had low LDL cholesterol levels except one case. LDL Cholesterol was <100 mg/dl in 99% cases with a mean LDL Cholesterol of 47.35 mg/dl.

**Table 5: LDLc levels in cases.**

| LDL c(mg/dl) | No. of patients | Percentage |
|---|---|---|
| <25 | 27 | 27 |
| 26-50 | 28 | 28 |
| 51-75 | 29 | 29 |
| 76-100 | 15 | 15 |
| >100 | 1 | 1 |
| Total | 100 | 100 |

***Total cholesterol levels***

Table 6 shows that total cholesterol levels were low in almost all the cases except one. Total Cholesterol levels were <200 mg/dl in 99% cases, 61 % cases were found to have levels between 50 to 100 mg/dl and levels <50 mg/dl in 18% cases. The mean total Cholesterol in the study was 86.04 mg/dl.

**Table 6: Total cholesterol levels in cases.**

| Total cholesterol (mg/dl) | No. of patients | Percentage |
|---|---|---|
| <50 | 18 | 18 |
| 50-100 | 61 | 61 |
| 101-150 | 19 | 19 |
| 151-200 | 1 | 1 |
| >200 | 1 | 1 |
| Total | 100 | 100 |

***Serum triglyceride levels***

Serum triglyceride levels were above the normal upper limits of 150 mg/dl in nearly 69% cases. In the study 69% cases had serum triglycerides more than 150 mg/dl and 25% cases had levels greater than 200 mg/dl. The mean serum triglyceride in the study was 169.31 mg/dl.

**Table 7: Serum triglyceride levels in cases.**

| Total triglycerides (mg/dl) | No. of patients | Percentage |
|---|---|---|
| <100 | 7 | 7 |
| 100-150 | 24 | 24 |
| 151-200 | 44 | 44 |
| >200 | 25 | 25 |
| Total | 100 | 100 |

***Correlation between parasite load and lipid levels***

Table 8 denotes that the degree of decline in HDLc, LDLc and total cholesterol as well as elevation in Serum Triglycerides is directly proportional to parasite load. Hypocholesterolemia and hypertriglyceridemia is directly proportional to parasite load.

**Table 8: Levels of parasite load and lipid levels.**

| Lipid | MPFT | Mean (mg/dl) |
|---|---|---|
| HDLc | 1+ | 19.75 |
| | 2+ | 21.02 |
| | 3+ | 13.62 |
| | 4+ | 10.83 |
| LDLc | 1+ | 55.16 |
| | 2+ | 57.02 |
| | 3+ | 32.62 |
| | 4+ | 29.66 |
| Total cholesterol | 1+ | 96.25 |
| | 2+ | 87.96 |
| | 3+ | 84.37 |
| | 4+ | 58.50 |
| S. Triglycerides | 1+ | 142.50 |
| | 2+ | 167.61 |
| | 3+ | 178.78 |
| | 4+ | 186.33 |

**Table 9: Levels of platelet count and lipid levels.**

| Lipid | Platelet count/cumm | Mean (mg/dl) |
|---|---|---|
| HDLc | <50,000 | 10.21 |
| | 50,000- 1lac | 10.38 |
| | >1 lac | 16.43 |
| LDLc | <50,000 | 28.93 |
| | 50,000- 1lac | 50.87 |
| | >1 lac | 44.43 |
| Total cholesterol | <50,000 | 65.64 |
| | 50,000- 1lac | 90.18 |
| | >1 lac | 80.14 |
| S. Triglycerides | <50,000 | 209.00 |
| | 50,000- 1lac | 160.42 |
| | >1 lac | 184.71 |

**Table 10: Levels of serum creatinine and lipid levels.**

| Lipid | S. creatinine (mg/dl) | Mean(mg/dl) |
|---|---|---|
| HDLc | <2 | 18.08 |
| | 2-2.5 | 14.00 |
| | 2.6-3.5 | 16.00 |
| LDLc | <2 | 48.43 |
| | 2-2.5 | 30.50 |
| | 2.6-3.5 | 34.00 |
| Total cholesterol | <2 | 87.76 |
| | 2-2.5 | 51.50 |
| | 2.6-3.5 | 67.80 |
| S. triglycerides | <2 | 167.35 |
| | 2-2.5 | 200.00 |
| | 2.6-3.5 | 185.60 |

**Table 11: Levels of serum bilirubin and lipid levels.**

| Lipid | S. bilirubin(mg/dl) | Mean(mg/dl) |
|---|---|---|
| HDLc | <2 | 19.31 |
| | 2-2.9 | 10.17 |
| | 3-5 | 11.30 |
| | >5 | 12.00 |
| LDLc | <2 | 51.77 |
| | 2-2.9 | 30.83 |
| | 3-5 | 23.70 |
| | >5 | 16.00 |
| Total cholesterol | <2 | 90.51 |
| | 2-2.9 | 64.17 |
| | 3-5 | 66.90 |
| | >5 | 38.00 |
| S. triglycerides | <2 | 163.42 |
| | 2-3 | 193.67 |
| | 3-5 | 203.80 |
| | >5 | 128.00 |

***Correlation between platelet count and lipid levels***

Table 9 shows hypocholesterolemia and hypertriglyceridemia is directly proportional to degree of thrombocytopenia. Hypocholesterolemia and hypertriglyceridemia was found to be more severe with greater decline in platelet counts.

***Correlation between serum creatinine and lipid levels***

Table 10 shows that hypocholesterolemia and hypertriglyceridemia is directly proportional to degree of kidney injury denoted by Serum Creatinine levels. In this study hypocholesterolemia and hypertriglyceridemia was found to be deranged to greater extent with worsening serum creatinine levels.

***Correlation between serum bilirubin and lipid levels***

Table 11 shows that hypocholesterolemia and hypertriglyceridemia is directly proportional to derangement in liver functions. Hypocholesterolemia and hypertriglyceridemia was found to be deranged to greater extent with increasing serum bilirubin level.

## DISCUSSION

This study involving the determination of serum lipid levels in patients diagnosed with *Plasmodium vivax* malaria was conducted on 100 inpatients of a Medical College Hospital who had blood smears and malarial parasite fluorescent test positive for *Plasmodium vivax*.

***Age distribution***

In this study, the disease occurrence was found to be predominantly in the third decade with a mean age of 28.2 years. In a similar study done in Korea the mean age was found to be 26 years.[2] The disease burden was mainly found to be distributed among adults who comprise the predominant working class of the population.

***Sex distribution***

In this study the disease incidence was mainly distributed among male population with a male to female distribution ratio of 4:1 in comparison to a ratio of 4.5: 1 demonstrated in a study done in Korea.[2]

This could probably be attributed to exposure to malaria prone environment and outdoor activities among males in comparison to females.

**Table 12: Comparison of cholesterol levels in various studies.**

| Study | J.S.Kim et al[2] | Omolola et al[3] | Sheshadri et al[4] | This study |
|---|---|---|---|---|
| Total cholesterol (mg/dl) | 76.1 | 67.14 | 109 | 86.04 |
| HDLc (mg/dl) | 16.7 | 15.48 | - | 17.89 |
| LDLc (mg/dl) | 29.6 | 37.8 | - | 47.35 |

**Table 13: Comparison of mean S. triglyceride levels in various studies.**

| Study | J.S.Kim et al[2] | Sheshadri et al[5] | Parola et al[6] | This study |
|---|---|---|---|---|
| Triglycerides mg/dl) | 95.9 | 204.3 | 34.56 | 169.3 |

***Cholesterol levels***

There was a significant decline in serum Cholesterol, HDL Cholesterol and LDL Cholesterol levels in the cases of vivax malaria participating in this study as depicted in Table 12, as it was also seen in the below studies. Among the participants, 138 (95.8%) were aware about the vaccine availability for the dog bite, out of 138, 125 (90.5%) said that the vaccine is available in Government Hospitals while 13 (9.4%) said in private hospitals. A

large number of participants answered 14injections 46 (31.9%) followed by 7 injections 22 (15.2%), 5 injections 28 (19.4%).

Hypocholesterolemia was present in nearly all cases of vivax malaria in this study. The decreased level of serum cholesterol was found to be directly proportional to the clinical severity of malaria, parasitic load, degree of thrombocytopenia, renal impairment and hepatic dysfunction in this study.

***Serum triglycerides***

The serum triglyceride levels were above normal levels in 69% cases of the study group in comparison to 76.9% of cases of *Plasmodium vivax* malaria participating in a study conducted in Tamil Nadu.[2]

Table 13 shows mean serum triglyceride levels compared across three studies. Hypertriglyceridemia was also found to be a common occurrence in most cases of vivax malaria, particularly in clinically, hematologically and biochemically severe form of disease.

## CONCLUSION

This study demonstrates the presence of altered serum lipid levels in the form of hypocholesterolemia and hypertriglyceridemia in cases of *Plasmodium vivax* malaria. The alteration in serum lipid levels may aid as a corroborative evidence in clinically suspected malarial infections in the absence of positive blood smear for malarial parasite particularly in febrile travellers from endemic areas.

The degree of derangement in lipid levels may serve as an indicator of severity of vivax malaria along with other biochemical and haematological parameters. The alteration in the serum lipid levels in the cases of malaria should not be falsely interpreted as the blood lipid status.

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