Original Research Article

THE EFFECT OF MALARIA ON LIVER FUNCTION IN CHILDREN BELOW 5 YEARS OF AGE

ABSTRACT

Malaria is the most frequent infection in tropical regions around the world. The goal of this study is to evaluate the effect of malaria on hepatocellular function in malaria-infected children aged between 1-5 years. After receiving institutional ethical clearance and informed consent from their parents, 582 randomly selected children aged 1 to 5 were enrolled. Test group was made up of 396 malaria-positive children, while the control group was made up of 186 apparently healthy children. The films (thin and thick) for malaria parasite with Giemsa staining validated the diagnosis of malaria, serum glutamic-oxaloacetic transaminase (SGOT) and serum glutamic-pyruvic transaminase (SGPT) using Reitman and Frankel method. Alkaline phosphatase (ALP), Gamma Glutamyl Transferase, albumin, and protein levels in the blood were measured as markers for liver assessment using P-nitrophenol, 5-amino 2-nitrobenzoate, bromocresol green and Biuret methods respectively. Patients with malaria parasitemia showed higher GammaGlutamyl Transferase, Serum Glutamic-Oxaloacetic Transaminase, Serum Glutamim-Pyruvic Transaminase and Alkaline Phosphatase levels in their blood, and lower albumin plus protein levels. When compared to the control group, the liver enzymes in malaria patients were considerably higher ($p < 0.05$) and albumin and total protein were considerably lower ($p<0.05$). The study has demonstrated that malaria parasitaemia causes impaired liver function in children between the age of 1-5 years. Therefore, it is suggested that hepatic function assessment should be included in malaria-endemic areas.

Keywords: *Serum glutamic-oxaloacetic transaminase; serum glutamic-pyruvic transaminase; alkaline phosphatase; gamma-glutamyl transferase*

1. INTRODUCTION

Malaria is still a health problem in several tropical and populated areas of the world [1]. Malaria in humans is caused by the following *Plasmodium* species; *Plasmodium falciparum, P. vivax, P. malaria, and P. ovale* but it has been postulated that a new species, *P. knowlesi* also infects humans [2]. The transmission of malaria is well aided by its vectors of which some species of female Anopheles mosquitoes are involved [3]. When blood is affected by malaria, it undergoes

some biochemical changes and complications are bound to occur as a result of the disease as shown in some studies [4].

One of the functions of the liver is to carry out carbohydrate, proteins and fats metabolism. During these metabolic pathways, some of the enzymes and the end products released are highly sensitive to the abnormalities that occur in the liver and these abnormalities can be measured and considered as biomarkers of liver dysfunction.

Liver cells are infected by the malaria sporozoites and this causes the organ to be congested and can also lead to sinus obstruction and inflammation of the cells. As a result of these changes in the hepatocytes, there may be leakage of parenchymal enzymes and membranous enzymes into the general stream [5]. Therefore, the increment in hepatic SGOT, SGPT and ALT in malaria patients further suggests that the serum levels of the liver markers increase with increasing *Plasmodium* density.

According to [6], this change suggests that the pre-erythrocytic stage (liver) of the parasite's life cycle in the human host is associated with profound disruption of hepatocyte membranes and hepatic parenchyma, resulting in the release of hepatic enzymes into the blood. It may indicate that there is a possibility of leakage.

During severe malaria attack, hepatic cells are usually involved in the pathophysiology of the disease and most times show in form of jaundice which occurs when bilirubin is raised, liver enlargement and when the enzymes associated with the hepatic cells are elevated [7]. Raised bilirubin in the blood primarily unconjugated is seen in malaria caused by *Plasmodium falciparum* and it is mainly as a result of haemolysis of erythrocytes that are parasitized and non-parasitized ones and sometimes as a result of liver damage.

The present study is concerned with an attempt to ascertain the changes in the hepatic functions of malaria infected children in the study area which will be valuable in the establishment of a reliable diagnosis and therapeutic interventions.

2. METHODOLOGY

Study area

The study was conducted among 1-5 years old children attending Rivers State University Teaching Hospital (RSUTH), Omega Children Hospital, and Palmers Hospital and Schools (Early Breed Group of Schools, St Francis Nursery and Primary school, and Staff Nursery and

Primary school) all in Port Harcourt, Rivers State. Port Harcourt is situated at latitude 4º 47´ 21´´ N and longitude 6º 59´ 54´´

Study design

This was a cross-sectional study conducted among randomly selected children between the ages of 1-5 years. A total of five hundred and Eighty-two (582) children were involved in this study. Three hundred and ninety-six (396) children had malaria and were regarded as the test group while one hundred and eighty-six (186) children who were not infected with malaria and were regarded as the control group.

Ethical Approval

Written informal consent was obtained from the parents of the children and the institutional authorities.

Eligibility

Inclusion criteria

The children included in the study include those within the age range of 1-5 years who had malaria with no history of hepatic disorders and were not on any anti-malarial drug. The control group had children who were not infected with malaria parasite and who had no history of any liver disease after laboratory trials by subjecting them to hepatitis B and C screening.

Exclusion criteria

Those whose parents did not give consent, children above ten (10) years of age, had any other underlining health issues, and children on anti-malaria treatments/drugs were excluded from the study**.**

Sample collection and analysis

About 10 ml of venous blood samples were collected aseptically with a disposable hypodermic syringe. About 4ml of which was dispensed into an ethylene diethyl tetra acetic acid (EDTA) sample container for malaria parasite analysis using thin and thick blood film technique to detect malaria presence [8-9] while Quantitative buffy coat used for estimation of parasitic densities [10]. While the remaining 6ml dispensed into heparin bottle and was used for liver function tests; total protein, albumin, alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase, and gamma-glutamyl transferase as parameters using Jendransik and Groff method, Biuret method, Amstrong method, Reitman and Frankel method and Rate method respectively [11-12].

Statistical analysis

Data obtained were subjected to statistical analysis using *t*-test and data were expressed as mean ±SD. This analysis was performed using Graphpad Prism 3.0 Package. The test was considered significant when $p<0.05$.

3. RESULTS

Table 1. below is on the Comparative Means (±SEM) of the Parameters of the Test and Control groups of 1-5years of age. The result revealed that children with malaria had significantly higher levels ($P<0.05$) of serum glutamic-oxaloacetic transferase (SGOT), serum glutamic-pyruvic transferase (SGPT), alkaline phosphatase (ALP), and gamma-glutamyltransferase (GGT) than the control group.

Table 1.: Comparative Means (±SEM) of Liver Function Test Parameters of the Test and Control.

Parameters	Test n=396	Control n=186	P-value
SGOT (iu/l)	18.29 ± 0.44	5.68 ± 0.15	P < 0.05
SGPT (iu/l)	8.71± 0.10	4.66 ± 0.13	P < 0.05
ALP (iu/l)	70.38 ± 0.80	17.29 ± 0.55	P < 0.05
GGT (iu/l)	21.86 ± 0.28	15.98 ± 0.25	P < 0.05
Protein (g/l)	42.71 ± 0.43	63.86 ± 0.82	P < 0.05
Albumin (g/l)	31.49 ± 0.35	53.50 ± 0.80	P < 0.05

Age Range: 1-5 years

4. DISCUSSION

Results obtained in the present study showed noticeable increment in activities of enzymes serum glutamic oxaloacetic-transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), and alkaline phosphatase (ALP), and a reduction in protein and albumin levels among children infected with malaria.

Thus, the findings confirmed that children aged 1 to 5 years are the most vulnerable, which is in line with the reports of [13, 14, 15]among others (2021). This could be due to a developing organ (liver), a developing immune system, a lack of protection from mosquito bites, high exposure rates, and nutritional factors [16].

Studies showed that increment in serum levels of liver enzymes, glutamic-oxaloacetic transaminase/glutamic-pyruvic transaminase (GOT/GPT), and alkaline phosphatase are used as markers of liver damage. The majority of the test subjects had elevated levels of liver enzymes, serum glutamic-oxaloacetic transaminases/serum glutamic-pyruvic transaminase (SGOT/SGPT), and alkaline phosphatase, indicating liver disease. The leakage of hepatic enzymes into the blood is directly proportional to the density of malaria parasites [17-18].

Raised bilirubin is usually caused by parasitized and non-parasitized RBC hemolysis and/or hepatocyte injury in uncomplicated malaria [19]. According to [20], although severe jaundice can occur, the condition is typically accompanied by a slight increase in hepatic enzymes and is more likely to be brought on by hemolysis than by hepatic injury. Previous research has shown that intravascular hemolysis and hepatic dysfunction were the primary causes of jaundice (42.1%) in the current study. Albumin levels were shown to be lower [21].

When comparing malaria-infected children to non-infected children, lower levels of albumin and protein were found. This is in agreement with [22] findings, who observed that participants infected with malaria had a 15% decrease in serum albumin levels. However, a reduction in albumin level could indicate an acute-phase reaction and aid in assessing prognosis at the time of admission. It was unsurprising to find that lower parasitemia individuals had higher albumin levels than those with moderate parasitemia, which was statistically significant ($p<0.05$).

The non-severity of the fever and other symptoms of malaria at such level could be attributed to the increased albumin levels. This finding is in consonance with [23] findings, who demonstrated that there was a drop in albumin level at high parasitemia when compared to low and moderate parasitemia, but that the difference was not statistically significant ($P>0.05$).

5. CONCLUSION

Malaria infection in Sub Saharan Africa has resisted approaches geared towards combating it, however, in the event of malaria infection, a high index of suspicion, prompt diagnosis, and prompt treatment are essential to avoid the morbidity and mortality associated with disease progression, especially in children. The significant decrease in serum albumin and protein levels, as well as an increase in ALP, SGOT, SGPT, and GGT, which are liver function parameters, suggest that high malaria parasitemia has a negative impact on the integrity and functions of the liver in children, which could lead to mortality if not treated.

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