The Alteration of Serum Glucose, Urea and Creatinine Level of Malaria Patients in Obowo Local Government Area of Imo State Nigeria

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Abstract The alteration in serum glucose, urea and creatinine were estimated in malaria patients. About 30 subjects (15 male and 15 female) with malaria parasitaemia were selected as test subject based on clinical symptoms’ and 30 healthy subjects with no malaria infestation were included as control subjects. The malaria parasite, serum glucose, urea creatinine were determined using a standard procedures. It was observed that the levels of serum creatinine and urea were insignificantly (p>0.05) higher in malaria patients with mean values of (9.3±4) mg/dl and (62.5±27) mg/dl, when compared the respective control values of (5.3±3.1) mg/dl and (34.2±5.2) mg/dl. Serum glucose level decreased significantly, (p<0.05) in malaria patients with mean value of (43±42) mg/dl when compared with control subjects of (77.6±67.3) mg/dl. When compared with respect to their sex, the increase in the serum creatinine was insignificant (p>0.05), while the differences in the plasma glucose level and urea were significant (p<0.05). Female has a higher level of serum urea (65.2±15.5) mg/dl, serum glucose (49.1±23.6) mg/dl and a lower value of serum creatinine (5.8±1.8) mg/dl, when compared with the respective male patients’ values, serum urea (59.9±11.4) mg/dl, serum creatinine (12.5±2.2) mg/dl and serum glucose (36.6±19.9) mg/dl. When compared with respect to their ages ranging from 20-40 years, 41-60 years and 61-80 years, it showed that there was no significant increase in serum creatinine and urea but the plasma glucose showed a significant decrease as they age. The result suggests that malaria infestation affects the serum glucose, urea and creatinine levels of both male and female malaria patients in Obowo Local Government Area of Imo state, Nigeria in equal ratios. The effect is more within the age bracket of 41-60 years.

Keywords Glucose, Urea, Creatinine, Malaria
1. Introduction

Malaria is a disease caused by protozoan parasites from *plasmodium* family that can be transmitted by either the sting of anopheles mosquito (vector transmission), blood transfusion, or congenital transmission [1]. Malaria can also be said to be a serious disease which is common in tropical climates and characterized by recurrent systems of chills, fever, and sweats often leading to anemia, an enlarged spleen and other complications that may result to loss of life. There are four species of the parasit that can infect man: *plasmodium vivax* causing vivax or benign tertian malaria; *plasmodium ovale*, which causes ovale malaria; *plasmodium malariae*, which causes malariae or quartan malaria; and *plasmodium falciparium*, the highly pathogenic causative organism of falciparium or malignant tertian malaria [1]. Malaria can either be acute or chronic (severe) and is frequently recurrent. Known since before the 5th Century BC, malaria occurs in tropical and subtropical regions near swamps, and some epidemiological factors that make malaria endemic in the tropics include climatic factors (relative humidity, altitude, rainfall level, mean temperature between 18-19°C) and socioeconomic factors as all this have effects on the availability of vectors which maintain the transmission of malaria [2]. It is common in Africa, central and South America, the Mediterranean countries, Asia and many of the Pacific islands. Possibly, over 90% of the estimated malaria infected people in the world are Africa with *falciparium* malaria taking majority of the cases [1]. Malaria remains a devastating global health problem. The World Health Organization estimates that there are 30 million to 50 million clinical case annually, resulting in approximately 1.5 million to 2.7 million deaths. Despite years of effort to eradicate it and subsequently to reduce its impact on mortality, it is still one of the major diseases in the world today [3]. According to the statistics of the United Nations Population Division in 1990, malaria is the only disease apart from AIDS that shows significant rising tendency [3]. Malaria has protean clinical manifestation. Malaria parasite interferes in three organs of the body namely liver, brain and kidney [4]. Recently, there is a changing trend not only in the clinical manifestation, but also the pattern of complications in malaria. Over the decade ago, cerebral malaria was the predominant significance of severe malaria, whereas today, there has been a serious case of hypoglycemia [1] and renal problems associated with malaria take the form of nephritic syndrome which gradually progress to renal failure [5]. Hypoglycemia is literally translated as low blood sugar. It occurs when blood sugar (glucose concentration) falls below level necessary to properly support the body's need for energy and stability throughout its cells. This can occur during severe malaria because the parasite feeds solely on glucose [6].

Considering the endemicity of malaria in Nigeria, the mortality rate cut across both sexes in the families, accurate prognosis and proper management are very necessary. The incidence of kidney problems hypoglycemia is on the increase in Nigeria, malaria and other infectious diseases may be contributing factors. It is therefore important to know the prevalence level of glucose and renal involvement in malaria cases to ensure effective management of patients as they report to different health centres. Not much has been done to establish the degree of alteration of serum urea, creatinine and glucose levels in malaria cases in Nigeria and in Obowo in particular. To gain insight into this we investigated the alteration of serum urea, creatinine and glucose levels among Nigerians diagnosed with *P. falciparum* malaria.

2. Materials and Methods

The study was conducted in Obowo, Imo state, Nigeria between May 2009 and July 2009. Obowo lies on latitude 57°E and 52°W and longitude 72-67°E, and is located in a rainforest belt of Imo state, endemic for *P. falciparum* malaria parasite which is transmitted by the female anopheles mosquito. It has a rainy period from April-November which is when the bite of mosquito is more rampant. The rainforest belt where the state is located is also a very good site for mosquito habitat. Obowo has a population comprising workers in the private sector, civil servants, students, traders, self-employment,
farmers etc. The study subject consists of 60 subjects between the ages of 20-80 years who attending clinic at various hospital within Obowo metropolis, Imo state Nigeria. The study subjects were adults 30 with *P. falciparum* malaria parasite who reported ill with fever (axillary temperature >37.5°C) headache, vomiting, diarrhoea, respiratory distress and other clinical signs and symptoms of malaria as previously documented and also have not been placed on any anti-malarial drug. The adults who did not meet these criteria were excluded from the study. Apparent healthy adults, of the same age bracket consisting of 15 subjects who were found to be negative for *P. falciparum* in their peripheral blood were used as controls. Both groups of subjects must have resided in Obowo for at least 8 years before the study. The scope, nature and objective of the investigation were thoroughly explained to the various subjects for their consent which was sought and obtained.

Using a 5 ml sterile plastic syringe, 4 ml of whole blood was drawn from each subject. It was allowed to stand until serum was separated from the clothed blood. The serum was carefully transferred into a sterile container. It was stored at 2°C -4°C and transferred immediately to the laboratory for research.

*Plasmodium falciparum* parasitaemia was determined in peripheral blood smears stained by Giemsa stain. The thick and thin films were analysed for the number of parasites per 200 white blood cells. Slides were considered negative if no parasites were seen in 100 fields in the film. Glucose was estimated using glucose oxidase method, creatinine was estimated using creatinine kinase method, and serum urea levels were estimated using urease-berthelot method. The data obtained were subjected to statistical analysis.

### 3. Results

Results were obtained from sixty (60) subjects; thirty healthy subjects (control) and thirty malaria patients (test subjects).

<table>
<thead>
<tr>
<th>Parameters (mg/dl)</th>
<th>Sample No</th>
<th>Control Mean±SD</th>
<th>Test Mean±SD</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>30</td>
<td>5.3±3.1</td>
<td>9.3±4.0</td>
<td>(p&gt;0.05)</td>
</tr>
<tr>
<td>Urea</td>
<td>30</td>
<td>34.2±5.2</td>
<td>62.5±27.0</td>
<td>(p&gt;0.05)</td>
</tr>
<tr>
<td>Glucose</td>
<td>30</td>
<td>77.6±67.3</td>
<td>43.0±42.0</td>
<td>(p&lt;0.05)</td>
</tr>
</tbody>
</table>

Table 1 shows the mean±SD valves of serum creatinine, urea and glucose. The analysis shows that there was an insignificant increase (p>0.05) in the mean±SD values of creatinine and urea, 9.3±4 mg/dl and 62.5±27.0 mg/dl respectively when compared with control subjects of mean±SD values of 5.3±3.1 mg/dl and 34.2±5.2 mg/dl. There was a significant decrease (p<0.05) in the mean±SD value of serum glucose 43.0±42.0 mg/dl when compared with the control subject of 77.6±67.3 mg/dl.

<table>
<thead>
<tr>
<th>Parameters (mg/dl)</th>
<th>Sample No</th>
<th>Control Mean±SD</th>
<th>Male Mean±SD</th>
<th>Female Mean±SD</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>15</td>
<td>5.3±3.1</td>
<td>12.5±2.2</td>
<td>5.8±1.8</td>
<td>(p&gt;0.05)</td>
</tr>
<tr>
<td>Urea</td>
<td>15</td>
<td>34.2±5.2</td>
<td>59.9±11.4</td>
<td>65.2±15.5</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Glucose</td>
<td>15</td>
<td>77.6±67.3</td>
<td>36.6±19.9</td>
<td>49.1±23.6</td>
<td>(p&lt;0.05)</td>
</tr>
</tbody>
</table>
Table 2 shows the mean±SD values of serum creatinine, urea and glucose of different sex (male and female). It shows that there was a significant decrease (p<0.05) in the mean±SD value of the female when compared to the male serum urea and glucose of 65.2±15.5 mg/dl; 59.9 ±11.4 mg/dl; and 49.1± 23.6 mg/dl; 36.6±19.9 mg/dl respectively while there was no significant difference (p>0.05) in the serum creatinine level between the female mean±SD values of 5.8±1.8 mg/dl and the male mean±SD values of 12.5±2.2 mg/dl.

Table 3: Level of serum creatinine, urea and glucose of malaria patients between the age 20-40 years, 41-60 years, and 61-80 years when compared with respective control subjects

<table>
<thead>
<tr>
<th>Parameters (mg/dl)</th>
<th>Control (mg/dl)</th>
<th>20-40 yrs. (mg/dl)</th>
<th>41-60 yrs. (mg/dl)</th>
<th>61-80 yrs. (mg/dl)</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>5.3±3.1</td>
<td>7.2±3.8</td>
<td>10.2±3.6</td>
<td>10.0±3.7</td>
<td>(p&gt;0.05)</td>
</tr>
<tr>
<td>Urea</td>
<td>34.2±5.2</td>
<td>61.6±12.4</td>
<td>66.9±14.3</td>
<td>59.1±13.7</td>
<td>(p&gt;0.05)</td>
</tr>
<tr>
<td>Glucose</td>
<td>77.6±67.3</td>
<td>43.9±30.9</td>
<td>47.6±21.9</td>
<td>37.1±23.2</td>
<td>(p&lt;0.05)</td>
</tr>
</tbody>
</table>

Table 3 shows the mean±SD values of the serum creatinine, urea and glucose of malaria patients with respect to the ages of the patients. The mean±SD of the serum creatinine increased from 5.5±3.1 mg/dl on control subject to 7.2±3.8 mg/dl; 10.2±3.1 mg/dl and 10.0±3.7 mg/dl in 20-40 years; 41-60 years and 61-80 years respectively. Statistically, the increase is significant (p<0.05). The urea level increased from 34.2±5.2 mg/dl on the control to 61.6±12.4 mg/dl; 66.9±14.3 mg/dl and 59.1±13.7 mg/dl in 20-40 years; 41-60 years and 61-80 years respectively. The increase is statistically insignificant (p>0.05). The serum glucose mean±SD value decreased from 77.6±67.3 mg/dl on the control subject to 3.9±20.9 mg/dl; 6±21.9 mg/dl and 37.1±23.2 mg/dl in 20-40 years, 41-60 years and 61-80 years respectively. Statistically the decrease is significant (p<0.05).

4. Discussion

The natural history of malaria is variable due to many of the host factor immunity being most important. In the immune adult belonging to an endemic zone like African, parasiteamia may not be accompanied with fever or illness even at its heavy state. In contrast, in non-immune adults, primary attack can be rapidly fatal, Bhattacharyan and Manesh; (1998) [7].

Acute renal failure and hypoglycemia are serious complications of falciparium malaria that is common among adults in South East Asia and Africa and also carries a high mortality [8]. The contribution of malaria to the number of cases of acute renal failure and hypoglycemia in any particular setting depends to a large extent on the local prevalence of malaria and on the pattern of the referral specialized centre [9]. Acute renal failure in malaria is usually oliguric and hypercatabolic. The oliguric phase lasts for few days to several weeks. Serum urea increases more rapidly than serum creatinine as a result of increased protein breakdown noticed in malaria patients. Statistically, the increase is insignificant when compared to the control. Between male and female, there was significant difference because the value of urea is slightly lower in males than in females. There was no significant difference between the age groups but the urea level was noticed to increase with age.

Creatinine levels slightly increased due to damage to the kidney and with this; there was reduced glomerular filtration rate due to inflammation of the kidney caused by the malaria parasite. Because of the malaria parasite and septicemia, acute renal failure resulted in most of the patients due to reduced flow of blood to the kidney. This is line with the view of Chen et al; 2000, [10] which states that the plasmodium falciparum displays adhesive proteins on the surface of infected red blood cells causing the blood cells to stick to the walls of small blood vessels, forming a mass and thus blocks the high endothelial venules which prevents flow of blood to the kidney and hence acute renal failure and accumulation of creatinine in the body fluid (blood). There was no significant increase in the creatinine.
level among male and female patients. Creatinine level slightly increased with age with no significant difference between the age groups.

Urea and creatinine are good indicators of a normal functioning of the kidney and increase of the substances in the serum are indications kidney dysfunction, although several factors such as excessive protein intake, shock, gastrointestinal hemorrhage etc. could also contribute to this [11].

Blood glucose is the main source of energy used by the body. In malaria, the serum glucose concentration decreases, this is as a result of the increased consumption of glucose by the parasite [6]. This is in line with the view of Ribeiro et al 2003; [12] that says that the mosquito’s saliva contains enzymes that aid in sugar feeding. Statistically, the decrease in the plasma glucose level is significant (p<0.05) when compare to the control. There was a significant difference between the male and female patients because the value of serum glucose is slightly lower in males than in females.

Creatinine and glucose level are markedly altered in the males more than in the females suggesting that the effect of malaria is more observed in the males than in the females. This is because men are bitten by mosquitoes more than women because they are always out doors and have large body mass and thereby excrete more carbon dioxide which is a mosquitoes attractant [13]. Also the glucose level is altered in individuals who fall within the age bracket of 41-60 years more than other age bracket, this is because adult become less attractive to mosquitoes as they age [14].

5. Conclusion

Following result and analysis of this study, it can be concluded that serum glucose, creatinine and urea are markedly altered in patients with severe malaria. The alteration is seen to decrease the glucose level causing hypoglycemia and increase the urea and creatinine level leading to acute renal failure. This alteration is significantly seen in males than in females, and more in those who fall within the age bracket 41-60 years.

References


