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Research Article

The Effect of Falciparum Malaria on Secretion of Serum α–-Amylase and Insulin by the Pancreas, Gezira state, Sudan

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Abstract: The objective of this study is to determine, the effects of falciparum malaria parasites on pancreatic secretions specifically the serum α–amylase and insulin concentration. The study was conducted in Gezira state, Eastern Locality (Rufa'a), during September 2011 to March 2012, when transmission reaches the peak. 104 patients of well defined malaria case participated as a study group and 40 apparently healthy volunteers participated as a control group from both sex and their ages vary from 10 to 60 years old. Venous blood sample was taken from each individual before and after anti-malarial therapy and analyzed for α-amylase activity by using colorimetric method, and insulin hormone level by using Immunochemilumino-metric assay. 35 out of 104 (33.7%) of the enrolled patients shows high level of serum α–amylase, while the remainder 69 (66.3%) have normal α-amylase, (23.3%) subjects suffering from abdominal pain. Results obtained when comparing, serum α-amylase level of the study group with the control group it shows significant difference (P. value 0.002). The α-amylase level is significantly increased in patients with malaria, when it compared with its level after complete recovery (P. value 0.000). The α-amylase level in patients with malaria suffering from abdominal pain, shows a significant difference when it compared with those without abdominal pain (p.value0.04). When comparing the α-amylase level with malaria parasite density groups (scanty, moderate, high, very high) it shows insignificant differences P. values (0.52, 0.23, 0.46, 0.07, 0.76, 0.10) respectively. From a total of 104 patients 65(62.5%) with normal insulin level, while the remainder 31 patients (29.8%) with low insulin level, the other 8 patients (7.7%) show's elevated insulin. Results obtained when comparing serum insulin level of the study group with the control group it shows significant difference (P. value 0.027). The insulin level when it compared between before treatment and after complete recovery (P.value0.000). When comparing the insulin level, with malaria parasite density groups, it shows insignificant differences P. values (0.62, 0.32, 0.60, 0.15, 0.91, 0.14) respectively. Falciparum malaria which has various complications may present as an acute pancreatitis, so serum α-amylase must be done as a routine test for patients with malaria suffering from severe abdominal pain so as to help in early diagnosis of pancreatitis, also blood glucose and serum insulin estimation are of value.
Keywords: Falciparum Malaria, Amylase, Insulin, abdominal Pain.

INTRODUCTION

Malaria can occur as soon as even days after an infectious bite and almost all cases of *falciparum* malaria occur within 16 days after the bite in people not taking a prophylactic drug or people using inadequate prophylaxis. Other important causes of fever in the returned travellers include typhoid fever, dengue, brucellosis, hepatitis, urinary tract infection, tick typhus, and rarely amebic liver abscess.

Although a blood smear is required to make the final diagnosis, the most important aspect of diagnosis is always to think of malaria as a possible cause of your illness. This is especially important because not every case of malaria presents with typical periodic fever pattern [1].

Amylase is a name given to glycosidic hydrolase enzyme, it's made primarily by the pancreas and salivary gland, it is also found in fallopian tube, liver and small intestine [2]. Amylase is a flexible linear polymers of glucose residues joined by a-1, 4 glycosidic bond which may be formed from several thousands glucose molecules. In humans, amylase is composed of 496 amino acids in a single polypeptide chain, which is encoded in chromosome 11 as part of multigene family. These genes are regulated, so that different iso-enzymes are synthesized in either salivary glands or pancreas. The salivary and pancreatic

amylase is highly typical in terms of primary sequence [3], but they have different cleavage patterns. The function and differences observed undoubtedly arise from the 15 amino acid substitutions between these sequences, some of which occur in the putative active site region. Amylopectin, however, is a branched molecule of glucose residues joined by either the a-1, 4 or a-1, 6 glycosidicbond [4].

The physiologic effects of insulin are far-reaching and complex. They are conveniently divided into rapid, intermediate, and delayed action. The best known is the hypoglycemic effect, but there are additional effects on amino acid and electrolyte transport, many enzymes, and growth. The net effect of the hormone is storage of carbohydrate, protein, and fat. Insulin acts a role on adipose tissue, skeletal, cardiac, smooth muscle and liver [5].The objective of this study was to evaluated falciparum malaria parasite effect on pancreatic secretion of serum α-amylase and Insulin.

MATERIAL AND METHODS

It's a prospective analytical laboratory study. The study was conducted in Rufaa city irrigated area in the central of Sudan, where the malaria is mesoendemic to hyperendemic with unstable transmission pattern. The field work was carried out during the peak transmission of malaria, from September 2011 to March 2012. During malaria transmission season two samples of blood specimen was taken from each simple falciparum malaria patient, who were diagnosed clinically and confirmed microscopically by blood film slides according to the general criteria of selection.

All the patients were managed by the clinician. The first blood sample was taken immediately after diagnosis (before administration of anti-malarial treatment), and the second blood sample was taken after 15 days from the onset and after complete recovery from malaria disease.

Samples were analyzed for malaria parasite count, glucose, and α-amylase immediately (objective 1-2). For insulin estimation serum was separated immediately, frozen and then stored at -20 . All blood samples were analyzed under supervision of expert technologist and in reference laboratories. Malaria diagnosed according to WHO protocol, other investigation, insulin, amylase assayed according to International Protocol System(IPS). 129 volunteers were participated in this study, 25 subjects were excluded according to exclusion criteria, 104 volunteers were selected as a test group and 40 volunteers as control.

Ethical consideration

The local ethics committee approved the study and all patients participated after informed consent and completed a pre-tested questionnaire, and then underwent a medical and physical examination by a doctor .

Statistical analysis:

Data was analyzed by using SPSS (Statistical package for social science). The mean and the standard deviation were calculated using statistical method and t.test to study the significance between two variables.

RESULTS

129 volunteers were participated in this study, 25 subjects were excluded according to exclusion criteria, 104 Patients are affected by P.falciparum malaria were included in this study, their ages vary from 10 -60 years old from both sex male and female table No(1) The frequency of malaria parasite density of the study group as follow: 52(50%) with low malaria parasite density (scanty), 27 (26%) moderate, 7(6.7%) high and 18(17.3%) with very high malaria parasite density table (2).

40 volunteers gender and place matched healthy individual participated as a control group. 35 out of 104 (33.7%) of the enrolled patients shows high level of serum α–amylase, while the remainder 69 (66.3%) have normal α-amylase level table No (3). Sample was repeated for the 35 subjects after recovery. The mean of serum alpha-amylase in parasite density is (scanty , moderate , high , very high) Fig(1).When comparing the α–amylase level with malaria parasite density it shows that there is no significant difference(P. value 0.52,0.23, 0.46, 0.07, 0.76, 0.10). α-amylase level not co-related with malaria parasite density table No(4). The mean level of serum α-amylase for the study group was 212.95, while the mean level for the control group was 153.5, with significant difference P. value (0.002) table No(5).

The mean level of α-amylase before and after anti-malarial therapy was 346.85 (before) and 205.57 (after) which show insignificant value with P. value (0.000) table No (6). The mean level of α-amylase in patients affected by malaria who are suffering from abdominal pain was 178.6, while the mean of α-amylase level in patients without abdominal pain was 226.22 with P. value (0.04) table No(7). From a total of 104 patients 65(62.5%) with normal insulin level, while the remainder 31 patients (29.8%) with low insulin level, the other 8 patients (7.7%) show's elevated insulin level table No(8).Sample was repeated for the 39 subjects after recovery. The mean of serum Insulin in parasite density is (scanty , moderate , high , very high) Fig(2).When comparing the Insulin level with malaria parasite density it shows that there is no significant difference(P. value 0.62, 0.32, 0.60, 0.15, 0.91, 0.14). Insulin level not co-related with malaria parasite density table No(8). The mean level of serum insulin for the study and control groups was 12.18 and 12.0 with P. value 0.027 table No (9). When comparing serum insulin level for the study group before and after

anti-malarial therapy, the mean level (before) was 11.9,
(after) was 11.1 with P. value (0.000) table No (10).

Table-1: male and female ratio in the study.

Variable	Number	Percentage
Male	41	39.4%
Female	63	60.6%

Table -2: percentage of malaria parasite density in the study group before treatment administration.

Variable	Frequency	Percent
Scanty (+)	52	50 %
Moderate (++)	27	26 %
High (+++)	7	6.7 %
V .high (++++)	18	17.3 %

Table-3: the percentage of α-amylase level in the study group before anti-malarial administration.

Variable	**Frequency**	**Percent**
Normal	69	66.3%
Abnormal	35	33.7%
Total	104	100%

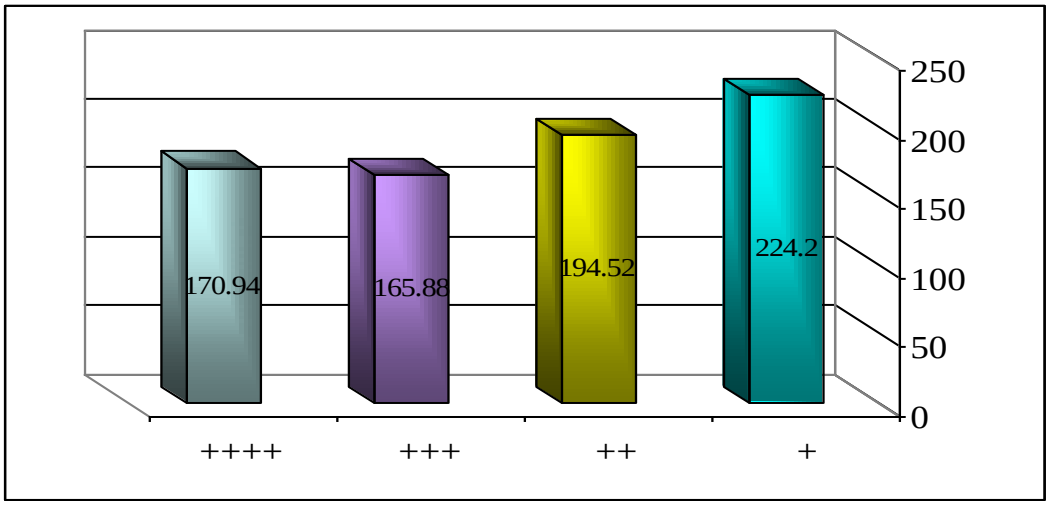

Fig-1: The mean of serum amylase with parasite density.

Table-4: Serum α-amylase level in relation to malaria parasite density.

Variable	**No**	**Mean**	**Std deviation**	**T.test**	**P.value**
Scanty	52	224.07	145.8	0.973	0.52
Moderate	27	193.52	101.6		
Scanty	52	224.07	145.8	0.08	0.23
High	7	229.14	239.2		
Scanty	52	224.07	145.8	0.552	0.46
v.high	18	203.67	96.79		
Moderate	27	193.5	101	0.6	0.07
High	7	229	139.2		
Moderate	27	193.5	101	0.336	0.76
v.high	18	203.6	96.7		
High	7	229	239.2	0.387	0.103
v.high	18	203.6	96.7		

Table -5: Comparison in serum α-amylase level between the study group and the control group.

Variable	No	Mean	Std deviation	T.test	P.value
Study group before treatment	104	212.95	134.8	2.7	0.002
Control group	40	153.5	52.8		

Table-6: Comparison in serum α-amylase level of study group before and after anti-malarial administration.

Variable	No	Mean	Std deviation	T.test	P.value
Before treatment	35	346.85	149.13	5.5	0.000
After treatment	35	205.57	15.44		

Table-7: Serum α-amylase level in those with and without abdominal pain (A.P).

Variable	No	Mean	Std deviation	T.test	P.value
With A.P	29	178.6	79.7	1.6	0.04
Without A.P	75	226.22	149.18		

Table -8: percentage of serum Insulin level in the study group before treatment administration.

Variable	Frequency	Percent
Low	31	29.8
Normal	65	62.5
High	8	7.7
Total	104	100

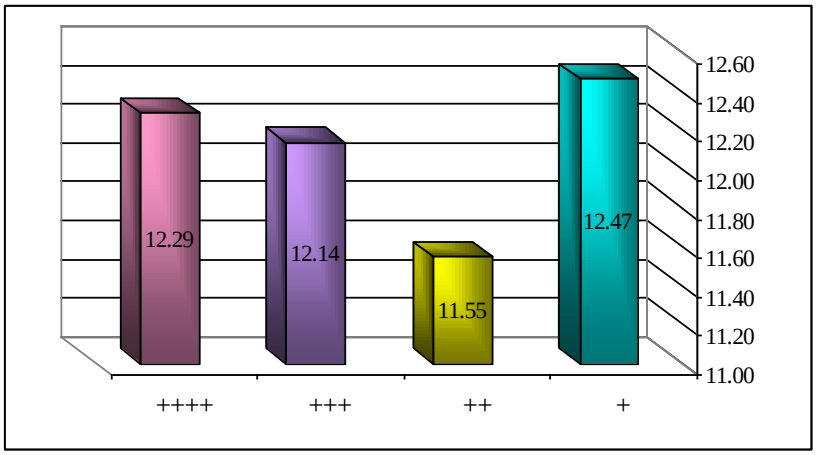

Fig-2: The mean of serum insulin with malaria density.

Table-9: Serum insulin level in relation to malaria parasite density.

Variable	No	Mean	Std deviation	T.test	P.value
Scanty	52	12.3	11.3	0.2	0.62
Moderate	27	11.6	9.3		
Scanty	52	12.3	11.3	-1.03	0.32
High	7	17.2	11.2		
Scanty	52	12.3	11.3	0.57	0.60
v.high	18	10.6	8.6		
Moderate	27	11.6	9.3	-1.21	0.15
High	7	17.2	15.2		
Moderate	27	11.6	9.3	0.38	0.91
v.high	18	10.6	8.6		
High	7	17.2	15.2	1.3	0.14
v. high	18	10.6	8.6		

Table-10: Comparison in serum α-amylase level between the study group and the control group.

Variable	No	Mean	Std deviation	T.test	P.value
Study group before treatment	104	212.95	134.8	2.7	0.002
Control group	40	153.5	52.8		

Table-11: Comparison in serum α-amylase level of study group before and after anti-malarial administration.

Variable	No	Mean	Std deviation	T.test	P.value
Before treatment	35	346.85	149.13	5.5	0.000
After treatment	35	205.57	15.44		

DISCUSSION

It is a prospective study; the field work was carried out during the peak transmission of malaria, from September 2011 to March 2012.

The study was conducted in Gezira eastern locality (Rufaa hospital), Gezira state irrigated area in the central of the Sudan where the malaria is mesoendamic to hyperendamic with unstable transmission pattern. α-amylase level increased in 33.7% patients affected by malaria. Out of 29 patients with malaria suffering from abdominal pain (23.3%) subjects with hyperamylaseamia, while (76.7%) with normal α-amylase level.

In a similar study of malaria presentation done by Khalid Mahmood [6]. in Hospital Karachi and Ankle Sria Hospital Pakistan. He reported that out of 108 P.falciparum smear positive patients, males were (68.51%) and females were (31.48 %). Fever was present in all patients, abdominal pain in (21.29 %), (8.3%) subjects with acute abdominal pain simulating the picture of acute pancreatitis, but serum α-amylase and ultrasound exclude the diagnosis of acute pancreatitis. Abdominal pain may result from the accumulation of malaria parasite in intestine [7].

In our study serum α-amylase increase in 35 patient (mean 346.85) with malaria, and after recovery serum α-amylase return to the normal range with significant difference (P. value 0.000), this result in agreement with case reports done by M.K.Mohapatra [8] in India, in three cases of complicated malaria with high α-amylase, treated with injection artesunate, injection imipinem and intravenous fluids. After 8 day's serum α-amylase level returned to the normal range.

Case study reported by Bijoy kumar [9] of a 41 years old male, the patient recovered within span of 7 days after which the malaria parasite (MP) was negative. Serum α-amylase came down respectively on 7^{th} day.

Also Sunil Kumar [10] presented a case report of 35 years old Indian tribal male, attacked by complicated malaria with severe abdominal pain and high α-amylase level, Patient was diagnosed as having severe falciparum malaria with acute pancreatitis, treated with intravenous quinine. Fever came down and abdominal pain subsided after the 8th day.

The patients complain from abdominal pain and high α-amylase level. After anti-malarial administration and complete recovery from malaria symptoms and abdominal pain, their α-amylase level return to the normal range, that means the increase in α-amylase may be due to accumulation of malaria parasite in the pancreas as a one of the vital organ or a complication of malaria.

In this study (37.5%) subjects have abnormal serum insulin level which return to the normal range after recovery with (P. value 0.000), (29.8) with low serum insulin and normoglycemic (from 100 to 125mg/dl).

In similar study done by GS. Atabani; et al [11] of severe hypoglycemia and hyperinsulineamia in Sudanese children affectsd by P.falciparum, reported that (26%) subjects have an insulin level below the detection limit of the assay.

White N J; et al [12] noted that plasma concentration of insulin and C peptide were inappropriately high ($p<0.05$).

In our study there were (7.7%) subjects with high insulin level. The accumulation of parasitized erythrocyte (occasionally causing thrombosis and infracts) is more common in the vital organs including pancreas, so it may block the secretion of insulin directly in blood stream.

CONCLUSION

Falciparum malaria parasite affect pancreas secretion especially serum α-amylase and serum insulin. When malaria treated well and patients recovered, serum α-amylase and serum insulin return to normal. Falciparum malaria effect on pancreatic secretion is not related to parasite density.

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