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Liver Function Assessment in Malaria, Typhoid and Malaria-Typhoid Co-Infection in Aba, Abia State, Nigeria

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Abstract: Malaria and typhoid fever are among the most endemic diseases in the tropics and are associated with poverty and underdevelopment with significant morbidity and mortality. Both diseases can lead to liver damage if not properly treated. The liver function assessment was therefore conducted on (90) volunteer patients; comprising (30) patients with malaria only, (30) with typhoid only and (30) with malaria-typhoid co-infection randomly selected from Abia State University Teaching Hospital, Aba, Abia State, Nigeria and (20) healthy individuals were used as control. Blood samples collected from these subjects were screened for malaria parasite and *Staphylococcus typhi* using standard methods. Mean serum levels of ALP (112.55±84.23), AST (31.33±12.80), ALT (23.10±11.84), TB (19.43±5.02), CB (5.91±3.03) and ALP(116.69±48.68), AST (28.33±11.72), ALT (22.8±5.94), TB (19.31±5.84),CB (5.60±2.50) were obtained for those subjects with malaria and typhoid respectively and subjects with malaria-typhoid co-infection recorded the following; ALP (134.33±56.62), AST (33.97±8.43), ALT (24.40±4.37),TB (21.27±2.96),CB (6.58±3.10) while the control subjects had mean serum levels of ALP (71.05±18.18), AST (16.65±7.45), ALT (13.85±6.09),TB (10.05±4.85) and CB (3.00±1.67). These mean values were subjected to a statistical test using students t-test which revealed a significant increase ($p<0.05$).The results suggest that malaria, typhoid and malaria-typhoid co-infection can elevate ALP, AST, ALT,TB and CB serum levels and can lead to liver damage if not properly treated.

Key words: Liver function, assessment, malaria, typhoid, co-infection

INTRODUCTION

Malaria is caused by obligate intracellular parasites, which live in the host erythrocytes and remodel these cells to provide optimally for their own needs. The World Health Organization reports that malaria, the deadly parasitic disease is responsible for nearly ninety nine percent of death in Africa (Ogbodo *et al*., 2010). One-fifth of infants' death in Africa is also caused by the scourged of malaria (Snow *et al*., 2005; WHO, 2010). In Nigeria, approximately 0.25 million death of children under the age of five is caused by malaria yearly (UNICEF, 2009). Malaria is caused by protozoan parasites of the genus plasmodium, in human it is caused by *Plasmodium falciparum*, *Plasmodium malariae*, *Plasmodium ovale* and *Plasmodium vivax* (Breman, 2001).

Typhoid fever, on the other hand is widely recognized as a major public health problem in most developing tropical countries (Kayode *et al*., 2011). It is a systemic infectious disease characterized by an acute illness; the first typical symptoms are fever, headache, abdominal pain etc. Human being is the only reservoir and host for typhoid fever and is transmitted by faecally contaminated water and food in endemic areas especially by carriers handling food (Uneke, 2008). Malaria and typhoid fever are among the most endemic diseases in the tropics. Both diseases have been associated with poverty and underdevelopment with significant morbidity and mortality (White, 2011). These diseases have been associated with major negative economic impact in regions where it is widely spread (Ellis *et al*., 2006). Co-infection in parasitology is a term used to describe the simultaneous infection of a host by multiple pathogen species. An association between malaria and typhoid fever (malaria-typhoid co-infection) was first described in the medical literature in the middle of the 19th century and

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was named typho-malarial fever by the United States Army Doctor Joseph J. Woodward (1833-1884) in 1862. Typho-malarial fever was found among young soldiers during the American civil war who were suffering from febrile illness that seemed to be typhoid rather than a new species of disease (Bynum, 2002).

In the last 20 years, this relationship between malaria and typhoid has been confirmed by additional studies from Africa that largely described a higher incidence of *Salmonella bacteraemia* among patients with malarial *Parasitaemia* (Ammah *et al*., 1999). Although typhoid and malaria are caused by very different organisms and transmitted through different mechanisms, both diseases share rather similar symptomatology and individuals in areas endemic for both diseases are at substantial risk of contracting both diseases (Mackintosh *et al*., 2004). The liver is a vital organ present in vertebrates. It is the largest organ in the human body, located in the right upper quadrant of the abdominal cavity, resting just below the diaphragm and lies to the right of the stomach. The liver has a wide range of functions including detoxification of protein synthesis, production of biochemicals necessary for digestion, storing of glycogen, hormone production etc (Strickland, 1991).

Malaria parasite and typhoid bacteria interfere with the liver and its functions. The invasion of the liver cells by malaria parasite and typhoid bacterium can cause organ congestion, sinusoidal blockage and cellular inflammation (Jarike *et al*., 2002; Petit and Wamola, 1994). When these happen, the parenchyma transaminases and membranous alkaline phosphatase and gamma glutamyl transpeptidase enzymes of the liver leak out and find their way into the circulation, leading to increased enzyme activity (Burtis *et al*., 2001). The liver is enlarged during the early stage in malaria infection and it is affected during the second week of infection of typhoid fever where the bacteria causes the inflammation of the liver. Untreated malaria and typhoid fever can lead to damage of the liver.

MATERIALS AND METHODS

One hundred and ten (110) volunteers were randomly selected from inpatients and outpatients(male and female) with febrile illness in Abia State University Teaching Hospital (ABSUTH), Aba , Abia State, Nigeria. All the volunteers were within the age bracket of 22 and 40 years. Blood samples were collected from the patients and were screened for the presence of malaria parasite and *Staphylococcus typhi* infection who were categorized into 4 groups as follows; Group 1, 30 patients with malaria alone, Group 2, 30 patients with typhoid fever alone, Group 3, 30 patients with malaria-typhoid co-infection, Group 4, 20 patients with no malaria and typhoid fever from the same location with the febrile patients and were considered as a control group. In order to assess the liver function in malaria, typhoid fever and malaria-typhoid co-infection patients, liver function test which measures the presence of various chemicals in the blood made by the liver was carried out. Some of the liver function analysis which include; Blood Bilirubin level (Total and conjugated), Alanine Transaminase (ALT), Aspartate Transaminase (AST) and Alkaline Phosphatase (ALP) were conducted. The study population includes only the febrile patients that have been clinically diagnosed to have malaria, typhoid fever and malaria-typhoid co infection from the result of their malaria parasite and widal tests, respectively.

SAMPLE COLLECTION AND PROCESSING METHOD

Blood samples were aseptically collected from the patients. Two specimen bottles were used for each patient; anticoagulant bottles for malaria parasite test and sterile bottles for widal and liver function assays. Blood samples were collected with undue pressure on either the arm or the plunger of the syringe. The samples in anticoagulant bottles were tested immediately for malaria parasite after staining the film with field stain while those samples in the plain tube were allowed to clot and the clotted samples centrifuged to obtain the sera. The sera were separated into sterile bottles and were stored in the refrigerator at -20°C until analysis which were of course used for the widal and liver function assays within one week interval.

RESULTS

The results for the analysis of patients with malaria only, typhoid fever only and malaria-typhoid co-infection are shown below in Table 1, 2 and 3, respectively.

The mean values obtained for the various groups were subjected to statistical analysis for difference in means using students t-test and the results showed that there was a significant increase ($P<0.05$) in the liver function tests (ALP, AST, ALT, TB and CB) carried out on patients with malaria parasite only, when compared to the control.

Table 1: Variation in the mean values of serum level of different liver function tests carried out on patients with malaria parasite only and the control

	Test	Control		
Parameter	30 Mean±SD	20 Mean±SD	Normal range (Absuth, 2012)	p-value
ALP (IU L^{-1})	112.55±84.230	71.05±18.18	25-92.00000	p<0.05
AST (IU L^{-1})	31.33± 12.80	16.75±7.430	6-21.00000	p<0.05
ALT (IU L^{-1})	23.10±11.840	13.85±6.090	3-18.00000	p<0.05
TB (Umol L^{-1})	19.43±5.0200	10.15±4.850	3.4-17.1	p<0.05
CB (Umol L^{-1})	5.91± 3.030	3.00±1.670	0.0-3.40	p<0.05

Table 2: Variation in the mean values of serum level of different liver function tests carried out on patients with typhoid fever only and the control

	Test	Control		
Parameter	30 Mean±SD	20 Mean±SD	Normal range (Absuth, 2012)	p-value
ALP (IU L^{-1})	116.69± 48.68	71.05±18.18	25-92.00000	p<0.05
AS (IU L^{-1})	28.83±11.720	16.75±7.450	6-21.00000	p<0.05
ALT (IU L^{-1})	22.80±5.9400	13.85±6.090	3-18.00000	p<0.05
TB (Umol L^{-1})	19.31±5.8400	10.15±4.850	3.4-17.1	p<0.05
CB (Umol L^{-1})	5.60± 2.5000	3.00±1.670	0.0-3.40	p<0.05

Table 3: Variation in the mean values of serum level of different liver function tests carried out on patients with malaria-typhoid co-infection and the control

	Test	Control		
Parameter	30 Mean±SD	20 Mean±SD	Normal range (Absuth, 2012)	p-value
ALP (IU L^{-1})	134.33± 56.62	71.05±18.18	25-92.00000	p<0.05
AST (IU L^{-1})	33.97± 8.340	16.75±7.450	6-21.00000	p<0.05
ALT (IU L^{-1})	24.4±4.37000	13.85±6.090	3-18.00000	p<0.05
TB (Umol L^{-1})	21.27±2.9600	10.15±4.850	3.4-17.1	p<0.05
CB (Umol L^{-1})	6.58± 3.1000	3.00±1.670	0.0-3.40	p<0.05

DISCUSSION

Increase of ALT, AST and ALP obtained in this study agrees with the finding of Ignatius *et al.* (2008) who reported that patients with untreated malaria parasite have high levels of ALP, AST and ALT in their blood. He also stated that this increase in enzyme activities could be attributed to the destruction of the liver parenchyma by the malaria parasite leading to the leakage of the liver enzymes into the general circulation. The result which shows a significant increase ($p<0.05$) in the level of bilirubin (TB and CB) in patients with malaria parasite only correlates with the work of Kayode *et al.* (2011) who reported elevated bilirubin (TB and CB) in malaria patients while Etim *et al.* (2009) reported significantly raised bilirum levels in malaria patients.

Increased serum levels of the various enzymes in the liver function tests carried out on patients with typhoid fever only are indicative of a hepatocyte disorder. The liver function tests are used for evaluation of hepatic involvement during typhoid fever. According to Ali *et al.* (2007), elevated serum enzymes (ALP, AST and ALT) in his work were discovered in 85% of patients with typhoid fever. Morgenstern and Hayes (1991) and Mirsadraee *et al.* (2007) in their findings reported that 62 and 70%, respectively of patients with typhoid fever had elevated AST and ALT while Rasoolinejad *et al.* (2003) reported that 74% of patients with typhoid fever had elevated ALP.

For patients with malaria and typhoid co-infection, the results show a significant increase ($p<0.05$) in the levels of ALP, AST, ALT, TB and CB. Kayode *et al.* (2011) reported elevated bilirubin (TB and CB) in malaria and in typhoid co-infection patients which are as a consequence of haemolysis, but in severe cases can lead to the damage of the liver. For the increase in the levels of ALP, AST and ALT, Mbuh *et al.* (2003) reported that patients with malaria and typhoid co-infection have increased ALP, AST and ALT. Kanjilal *et al.* (2006) in their work discovered that 87.6% of patient with malaria and typhoid co- infection had elevated ALP, AST and ALT.

CONCLUSION

Malaria, typhoid fever and malaria-typhoid co- infection still remain a major public health problem in many developing countries of the world and when severe and untreated can lead to increase in the serum levels of Alkaline Phosphatase (ALP), Alamine Transaminase (ALT), Aspartate Transaminase (AST) and Bilirubin (Total Bilirubin (TB) and Conjugated Bilirubin (CB).

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