Prevalence of the malaria parasite in screened blood in a tertiary health centre in the malaria-endemic Niger Delta region of Nigeria.

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Blood transfusion services are an important part of healthcare delivery especially in resource-poor malaria-endemic settings. Blood is routinely screened for transfusion transmissible illnesses but not malaria. In order to determine the prevalence of malaria parasite in blood already screened for transfusion transmissible illnesses, a study was carried out at the Federal Medical Centre, Yenagoa. Blood samples were aseptically obtained from blood bags ready for transfusion and already confirmed as free from transfusion transmissible infections. Thick and thin blood smears were made for each sample and Giemsa-stained and the films examined under the microscope for malaria parasite. Parasite densities were estimated for the malaria positive slides. The ABO and Rhesus blood group types of the donors were also determined using standard techniques. The malaria parasite was detected in 24 blood samples, indicating a malaria parasitaemia prevalence of 12.56% (95% CI: 7.88% - 17.24%) in blood donors. The trophozoite of *Plasmodium falciparum* was identified in all the malaria-positive slides. Parasite density ranged from 62/µl to 98,167/µl of blood. The blood group O Rhesus D positive was the commonest blood group type, accounting for two-thirds of the donors. Also, most of the subjects with malaria parasite positive slides were of this blood group. There was no association between malaria parasitaemia prevalence and age or blood group types. There is a potential risk of transfusion transmitted malaria in blood already screened for transfusion. We recommend the inclusion of screening for malaria parasitaemia in routine investigations of potential blood donors in Bayelsa State, Nigeria.

**Keywords:** Blood transfusion, screening, malaria parasite, blood group types

INTRODUCTION

Blood transfusion is a necessary intervention to save lives and there is presently no substitute to human blood. However, transfused blood can also be a source of infections, as viral, bacterial and parasitic diseases could be transmitted. The presence of an efficient blood transfusion service capable of ensuring the provision of safe blood is therefore important in the successful delivery of quality health care.

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WHO recommends quality-assured screening of all donated blood for transfusion-transmissible infections - HIV, hepatitis B, hepatitis C, Treponema pallidum (syphilis) and where relevant Trypanosoma cruzi and plasmodium species (malaria) (World Health Organization, 2010). Routine screening for the malaria parasite is not done even in malaria-endemic regions except for India, although WHO recommends screening based on local epidemiological evidence.

There is therefore the potential danger of transmission of the malaria parasite by blood transfusion, especially in malaria-endemic areas, and transfusion-transmitted malaria (TTM) has witnessed an increase since first described in 1911 and remains one of the commonest transfusion transmitted infections (Bruce-Chwatt, 1983). The risk of TTM differs between low-endemic countries and regions of high prevalence of plasmodium infection in the general population (Bihl et al., 2007).

In transfusion transmitted malaria there is introduction of asexual forms (trophozoites) and this differs from natural infection in that pre-erythrocytic schizogony is absent, incubation period is shorter, and exo-erythrocytic schizogony is not seen (Chauhan et al., 2009).

Prevention of transfusion transmitted malaria is important because most of the patients in these malaria-endemic settings requiring transfusion are already weakened by illness and may not withstand the burden of added malaria parasite infestation.

With the need to establish local epidemiological evidence of TTM, this study was therefore designed to determine the prevalence of transfusion transmitted malaria in blood, certified free from transfusion transmissible infections (Hepatitis B and C, HIV and syphilis). Among blood donors in a tertiary hospital in Yenagoa, Bayelsa State of Nigeria. We also attempted to elucidate any association between transfusion transmitted malaria and the age or blood group types of the donors.

MATERIALS AND METHODS

Study design

A prospective descriptive study carried out over a six month period from May 2012 to October 2012, in which blood already screened for transfusion at the Blood Transfusion Services Department of the Federal Medical Centre (FMC), Yenagoa, Bayelsa State, Nigeria were analyzed.

Study area

Bayelsa State is situated in the Niger Delta region of Nigeria. The area is geographically in the tropical rain forest belt, and is endemic for malaria, with perennial transmission of malaria. The federal Medical Centre is a tertiary hospital located in Yenagoa, the capital city of Bayelsa State, Nigeria. The centre is the largest hospital in the state and also serves as a major blood bank in the state and its environs. The people are mostly fishermen, farmers and civil servants. The study was conducted during the peak period of the rainy season believed to have increased transmission of malaria.

Ethical Approval

Informed consent was obtained from every donor, and ethical approval was obtained from the appropriate Ethics Review Board.

Sample collection

2mls of blood was obtained each from 191 blood bags already screened for and confirmed to be free from transfusion transmissible infections (Hepatitis B and C, HIV and syphilis). The blood sample was collected by aseptically letting 2mls into a sterile Ethylene diamine tetra acetic acid (EDTA) - containing bottle.

Sample analysis

Thick and thin blood films were prepared for each sample and the smears were Giemsa-stained according to standard techniques. Prepared slides were each read twice independently by two experienced microscopists for concordance. Any discordance in results was resolved by re-examination by a third microscopist.

Parasite densities were estimated by counting the number of asexual parasites per 200 white blood cells (WBCs) and converted to parasites/µl assuming a total WBC count of 8000 per µl of blood (World Health Organization, 2010).

The ABO/Rhesus phenotypes were performed for all subjects using the slide method. Briefly, 3 drops of blood from each sample were placed separately on a clean tile. To each drop of blood, one of the antisera; anti A, anti B or anti D was added and then mixed with the aid of a glass rod. The blood groups were determined on the basis of agglutination.

Statistical analysis

Statistical analysis was performed with the Graphpad Prism version 4® (Graphpad software, San Diego, CA). Differences between groups were determined by the one-way analysis of variance (ANOVA) or paired t- test with the level of significance set at p < 0.05.
Table 1. Age distribution of the blood donors and frequency of malaria positive slides.

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>No. of donors</th>
<th>Malaria slide positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 to 20</td>
<td>37 (19.37%)</td>
<td>7 (29.17%)</td>
</tr>
<tr>
<td>21 to 30</td>
<td>131 (68.58%)</td>
<td>16 (66.7%)</td>
</tr>
<tr>
<td>31 to 40</td>
<td>20 (10.47%)</td>
<td>1 (4.17%)</td>
</tr>
<tr>
<td>41 to 50</td>
<td>2 (1.07%)</td>
<td>0</td>
</tr>
<tr>
<td>&gt;50</td>
<td>1 (0.52%)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>191</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 2. Density of malaria parasite expressed in numbers per µl of blood.

<table>
<thead>
<tr>
<th>Parasite density/µl</th>
<th>No. of subjects</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;100</td>
<td>4</td>
<td>16.67</td>
</tr>
<tr>
<td>100 - 1000</td>
<td>2</td>
<td>8.33</td>
</tr>
<tr>
<td>1001 - 10000</td>
<td>5</td>
<td>20.83</td>
</tr>
<tr>
<td>10001 - 50000</td>
<td>7</td>
<td>29.17</td>
</tr>
<tr>
<td>50001 - 80000</td>
<td>4</td>
<td>16.67</td>
</tr>
<tr>
<td>80001 - 100000</td>
<td>2</td>
<td>8.33</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>100</td>
</tr>
</tbody>
</table>

RESULTS

Blood samples certified free from transfusion transmitted infections from 191 blood donors were analyzed for malaria parasite and ABO Rhesus blood groups. The age range of the subjects was 17 years to 53 years, mean age 25.93 years. All the subjects were male. 68.58% of the donors were in the 21 to 30 years age group. Table 1 shows the age distribution and the frequency of malaria positive slides. Only one donor was over the age of 50 years (53 years).

Prevalence of malaria parasite

Malaria parasite was detected in 24 of the blood samples, meaning a prevalence of 12.56% (95% CI: 7.88% - 17.24%). In all 24 positive samples, the trophozoite of *Plasmodium falciparum* was detected (100%).

Level of parasitaemia

The parasite density ranged from 62/µl to 98,167/ µl of blood (Table 2). Eighteen (75%) of the slide positive subjects had parasite densities below 50,000/ µl of blood.

Age

Two-thirds of the subjects with positive malaria slides (16 subjects) were of the 21 to 30 years age group, whilst almost 30% of the slide positive subjects were of the 17 years to 20 years age group. There was no association between age and prevalence of malaria parasite.

Blood group

56.02% of the blood donors were of the blood group O Rhesus D positive (Table 3). No donors were of the AB blood group. 66.7% of the subjects with positive malaria slides were of the blood group O Rh D positive (Table 4). There was no association between blood group type and prevalence of the malaria parasite.

DISCUSSION

A high prevalence of the malaria parasite in blood already screened for transfusion should be a cause for concern since majority of the recipients are pregnant women,
In this study, we observed a malaria parasitaemia prevalence of 12.56% among blood donors. This is higher than the 4.1% to 10.25% obtained in other studies done in Nigeria (Akinboye and Ogunrinade, 1987; Emeribe and Ejezie, 1987; Chikwem JO et al., 1997; Erhabor O et al., 2007), but much lower than the 40.9% to 55% obtained by some other workers in Nigeria (Achidi et al., 1995; Ibhanesebhor et al., 1996; Okocha et al., 2005; Uneke et al., 2006; Epidi et al., 2008). A study in the Sudan obtained a similar figure - 13% (Ali et al., 2005). These differences are suggestive of local variations in the prevalence of malaria parasitaemia. More studies need to be done to ascertain the level of parasitaemia in the asymptomatic healthy population.
We detected only *Plasmodium falciparum* species from the malaria positive donors. This is similar to most of the studies done in Nigeria apart from a few (Emeribe and Ejezie, 1987; Okocha et al., 2005; Uneke et al., 2006) in which *Plasmodium malariae* was also detected. There is little information about the distribution of plasmodium species across Nigeria.

Two donors had parasitaemia levels above 80,000/μl of blood. The malaria parasitaemia threshold before symptoms appear is not known. The knowledge of this threshold may be important in the management of malaria-infected blood in malaria-endemic regions, as it could be used to determine blood that may be transfused or discarded.

Whether blood group types influence malaria infection is still not clear. In this study, the incidence of malaria parasitaemia was higher among the blood group O Rhesus D positive donors, but this can be attributed to the fact that they constituted about two-thirds of the donors. A previous study in Nigeria had associated blood group O with higher prevalence of malaria parasitaemia (Akhibge et al., 2011), whilst another study found no relationship (Uneke et al., 2006).

There is a need for more specific questioning of potential donors about malaria (Kitchen and Chiodini, 2006). A questionnaire for the deferral of high risk individuals could be helpful, as presently, blood donor cards do not carry sufficient information such as occupation, previous blood donation, previous blood transfusion or history of malaria. However, in malaria-endemic regions, there are semi-immune individuals with low level of parasitaemia who remain asymptomatic and may qualify as blood donors (Dubey et al., 2012).

It is also important to screen for malaria because a febrile transfusion reaction may be difficult to distinguish from a haemolytic transfusion reaction (Bahadur et al., 2010). In post-transfused patients, it could be difficult to distinguish between natural malaria due to mosquito bite and transfusion transmitted malaria. It is also not easy to ascertain the true risk of acquiring malaria from blood transfusion (Owusu-Ofori and Bates, 2012), because determining the prevalence of TTM in blood donors does not measure the risk. Studies involving the blood recipients would shed more light on the actual risk of TTM.

Healthcare systems ideally should be equipped to identify both the individual donor at risk of transmitting malaria, and the recipient at risk of being infected, and be able to manage transfusion infections when they occur.

Wide-scale screening of all donated blood for malaria could be cumbersome and costly in resource-poor settings. Also, the best screening method is yet to be agreed on. Whilst a study in Nigeria using microscopy as the gold standard observed that malaria rapid diagnostic tests (RDTs) were less efficient (Falade et al., 2009), an Indian study found malaria antigen detection more reliable (Choudhury et al., 1991). Malaria antigen also performed better than malaria antibodies in terms of sensitivity and specificity (Contreras et al., 2011). Microscopy is labour intensive, requires high technical skills especially when there is low parasitaemia (Payne 1988).

It is potentially difficult to maintain malaria-free blood supply in areas with perennial transmission of malaria, because all donated blood can be potentially infected with malaria parasite and deferral means a disruption in blood supply. Voluntary blood donation is yet to reach acceptable levels and discarding malaria-infected blood could compound the problems of maintaining a continuous blood supply.

We concur with an earlier recommendation that it would be beneficial to include screening for malaria parasitaemia in routine investigations of potential blood donors in Nigeria (Falade et al., 2009).

**CONCLUSION**

Our results highlight the potential risk of blood transfusion-transmitted malaria in a blood bank in Yenagoa, Bayelsa State of Nigeria. We therefore recommend for malaria-endemic countries like Nigeria, mandatory screening of all donated blood for the malaria parasite and the institution of guidelines to manage malaria-infected blood. The guidelines should strike a balance between the need for blood to save lives and the dangers of transfusing malaria parasite to already ill patients.

**REFERENCES**


