Epidemiology of Malaria in the British Army from 1982-1996

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SUMMARY: An epidemiological review was carried out of all known cases of malaria involving British soldiers between 1982-1996. Hospital records of 213 confirmed cases of malaria were obtained from the Defence Analytical Services Agency (DASA). More than half of the infections (52%) occurred as a result of military training in Kenya and 74% of these were due to Plasmodium falciparum which is potentially life-threatening. Mefloquine has been used as chemoprophylaxis by the British Army in Kenya since 1993 and the implications of this are discussed. There were no deaths in the series but malaria nevertheless remains a serious threat to the health of the British Soldier. The importance of adherence to chemoprophylaxis and of simple bite avoidance measures must continue to be emphasised.

Method

Copies of in-patient hospital records (F Med 14) for all Army personnel hospitalised in both military and civilian facilities worldwide with a diagnosis of malaria were obtained from DASA for the period 1982 to 1996. This was as far back as DASA was able to produce complete data. Disease notifications were not accessible for the period under study.

Records were examined for the chemoprophylaxis taken, the malarial region where infection was presumed to have occurred, the latency period before presentation, the species of malaria parasite demonstrated, the regimens used in treatment and any clinical complications that were observed. Only those cases which were confirmed by positive malaria blood smears were included in the analysis. Cases of pyrexia of unknown origin where there was no laboratory confirmation of malaria infection were excluded.

The data were collated and analysed using Epi Info version 6.02 software (CDC Atlanta, GA) and graphs were prepared using Microsoft office software (Microsoft Corporation USA, 1996).

Results

Of the 246 records obtained from DASA, 213 met the inclusion criteria for the study. Figure 1 shows the geographical distribution of these cases. Table 1 shows the species of malaria parasite according to geographical distribution. Of the cases of malaria contracted in Kenya 74% were due to P falciparum and of those contracted in Belize 84% were due to P vivax.

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Figure 2 shows the latency period of infection calculated for the different malaria parasites. The majority (90%) of cases of malaria due to *P. falciparum* presented in or within a month of leaving the malarious region while the cases due to *P. vivax* mostly presented many months later.

There were no fatalities during this period but sequelae were reported in 33 cases and these are summarised in Table 2. In addition to the complications listed, anaemia, hepatomegaly, splenomegaly, proteinuria, disordered liver function tests and thrombocytopenia insufficient to warrant specific therapy were reported in a large number of cases.

Figure 3 shows the incidence of malaria over time in British troops exercising in Kenya from 1984-96. The two preceding years have been omitted because of uncertainty regarding the at-risk population prior to 1984. The data are shown by training year rather than by calendar year since training takes place annually between October and April. The number of troops training each season has remained constant at around 2,500 except for a reduction at the time of the Gulf War when the exercise population was estimated at 1,700 troops. The attack rates can therefore be calculated and the mean attack rate for the whole period was approximately 0.03 cases of malaria infection per person-year of exposure.

**Table 1**

British Army malaria cases 1982-96, by parasite species identified

<table>
<thead>
<tr>
<th></th>
<th>Kenya</th>
<th>Belize</th>
<th>Elsewhere</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. falciparum</em></td>
<td>82</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td><em>P. vivax</em></td>
<td>21</td>
<td>36</td>
<td>37</td>
</tr>
<tr>
<td><em>P. malariae</em></td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><em>P. ovale</em></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Totals</td>
<td>110</td>
<td>45</td>
<td>61</td>
</tr>
</tbody>
</table>

Figure 3 shows an apparent four-year periodicity in the incidence of malaria in exercise troops in Kenya. Although...
numbers are small this fluctuation suggests either that the intensity of malaria parasite transmission varies from season to season in response to climatic factors or else that some units exhibit better malaria discipline than others. Analysis of the peaks, however, shows that they do not appear to correspond with the observed rainfall patterns in Kenya nor with the malaria trends seen in British tourists during this period (R. Behrens, personal communication).

Choosing the most appropriate chemoprophylactic regimen for use by the British Army has been an extremely difficult task over the years. The combination of chloroquine and proguanil was adopted by the British Army in 1985 after a British soldier in the reserve suffered fatal agranulocytosis while taking the previously recommended chemoprophylactic drug, amodiaquine. Chloroquine and proguanil remained the standard chemoprophylaxis for the British Army in most parts of the world until 1993 and Figure 3 indicates that there was a steady decline in the number of malaria cases in exercise troops in Kenya while this regimen was in use.

In 1993 the British Army changed to mefloquine as the standard chemoprophylaxis for troops exercising in Kenya because of concern about chloroquine resistance which had led to P.falciparum infection and some deaths in British tourists. Since then the decline in the incidence of malaria in British troops has continued but mefloquine has been associated with side effects and has been approximately three times as expensive as the preceding regimen (8,9). Behrens et al reported a three-fold reduction in the number of cases of malaria imported to UK from Kenya since the British malaria guidelines recommended for the first time the use of mefloquine as an alternative to chloroquine and proguanil chemoprophylaxis for East Africa (10). However, the continued decline in the incidence of malaria in exercise troops in Kenya since 1993 may also be due to the fact that troops no longer spend part of their exercise period in the Mombasa area where the risk of malaria can be extreme.

The debate about the most appropriate anti-malarial chemoprophylaxis for regions where chloroquine resistance is a growing problem is certain to continue at international level for many years (11). The main conclusion to be drawn from this epidemiological review is that malaria continues to represent a significant threat to the health of British soldiers making the importance of protective measures as great as ever. Other recent epidemiological studies of malaria have demonstrated that not only is the parasite capable of adaptation to become chloroquine resistant but the mosquito vector seems to have become less susceptible to the commonly-used insecticides. This latter problem is compounded by the periodic breakdown of vector control programmes in Kenya (12). There is therefore no justification for complacency about malaria.

The findings of the study demonstrate the need to adhere to all the recommended preventive measures, including compliance with chemoprophylaxis, and to maintain close surveillance both of the incidence of malaria and of the frequency and severity of side effects associated with the various chemoprophylactic agents. Soldiers must continue to be taught the importance of preventing malaria in endemic areas and both they and their health care professionals must be aware that infection may develop soon after returning to UK or up to a year or more later. Although most of the cases of P.falciparum malaria in this study presented in or within a month of leaving the malarious area there is now evidence that the use of mefloquine as chemoprophylaxis is tending to delay the onset of the disease in those who develop malaria (13). Any influenza-like illness developing even many months after return from a malarious area must therefore be fully investigated without delay.

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REFERENCES