Malaria in Papua New Guinea Implications for the British Army

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SUMMARY: Malaria poses the greatest health threat to British soldiers engaged in jungle training in Papua New Guinea. This paper provides detailed epidemiological information gained following a visit to the Papua New Guinea Malaria Research Unit in January 1986.

Introduction and Background
Papua New Guinea extends from the equator to Cape Baganowa at latitude 11.4° south, and from the border with Irian Jaya at 141° east longitude to 160° east longitude. The territory comprises a central land mass with many small islands. The population in 1980 was a little over 3 million.

The climate is tropical. In the lowland coastal areas the temperature ranges between a maximum of 32°C and a minimum of 21°C. The annual rainfall varies from 1000 mm near Port Moresby, to more than 6000 mm in the Huon peninsula. In the lowland jungles, the annual rainfall is about 4000 mm. There is no dry season, but relatively less rain falls between May and October.

The British Army holds company strength exercises in the jungles of the Sepik district near Wewak (Map I), and in the hinterland of Port Moresby. In the last 3 years, 42 cases of malaria have occurred in Gurkha soldiers involved in these exercises. As Papua New Guinea is likely to be the venue for future exercises, it has become imperative to review the malaria situation so that rational decisions can be made regarding protective measures.

Malaria Epidemiology
Malaria is endemic in all areas below 5000 feet, with only occasional Plasmodium vivax transmission at higher altitudes. In the coastal jungles the high temperatures and humidity favour malaria transmission throughout the year. In the Sepik and Madang districts mosquito biting rates are enormous. An unprotected man might expect more than 100 bites in one night. As the prevalence of mosquitoes harbouring malarial parasites may approach 4%, the malaria risk to soldiers is therefore also enormous. The area around Port Moresby is less malarious because of the drying effect of the South East Trade winds.

Plasmodial Species
All four human plasmodia are found in Papua New Guinea. Until 10 years ago, P. vivax and P. falciparum were dominant and equally represented. Considerable changes have occurred since then however, and the current distribution is, P. falciparum 70%-80%, P. vivax 15%-20%, P. malariae 5% and P. ovale 1%. Mosquitoes harbouring both P. falciparum and P. vivax are common, and in the Sepik district, mixed human parasitaemia accounts for just under half of all infections. Recent British Army experience confirms the high prevalence of mixed P. falciparum and P. vivax infections.

Map I. Malaria Distribution in Papua New Guinea

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Malarial Vectors
Of the 20 potential vector mosquitoes found in Papua New Guinea, only three are important. They are A. punctulatus, A. farauti and A. koliensis. These mosquitoes are long-lived and strongly anthropophilic. A. punctulatus favours river valleys but feeds indoors, with a peak biting period around midnight. A. farauti favours the coastal areas. It bites indoors with a peak biting period before midnight. A. koliensis is common around Wewak and feeds indiscriminately throughout the night.

The vector control programme has failed and has now been abandoned.

Plasmodial Resistance to Anti-malarial Drugs
Chloroquine. P. vivax, P. ovale and P. malariae remain fully sensitive. In 1976 chloroquine resistant P. falciparum was confirmed in Papua New Guinea and has since been widely reported. Currently, about 70% of P. falciparum is chloroquine resistant, but mostly at the RI level (RI 85%, RII 6% RIII 9%) .

Amodiaquine. Non-falciparum plasmodia are sensitive, but amodiaquine resistant P. falciparum was reported from the Madang district in 1981. Although amodiaquine may be superior to chloroquine in areas of chloroquine resistance, the drug has recently proved too toxic for large scale prophylaxis.

Proguanil. This drug was introduced during World War II and initially proved very effective. Resistance however soon appeared, and in 1960 P. falciparum was reported to be breaking through a dose of 200 mg daily, mirroring the situation in Vietnam. The strains of P. vivax and P. malariae found in Papua New Guinea seem also to have reduced sensitivity to proguanil. There has been renewed interest in proguanil-chloroquine combinations for prophylaxis of chloroquine resistant malaria. Recent British Army experience has shown this to be relatively ineffective in Papua New Guinea.

Pyrimethamine. Little information is available from Papua New Guinea although a report from 1961 suggested resistance was present.

Fansidar. There have been no formal prophylaxis studies, but in a test of therapeutic efficacy, a failure rate of 10% was noted against P. falciparum. Fansidar is intrinsically weak against P. vivax.

Maloprim. Like fansidar, maloprim is weak against P. vivax. It is however, extremely effective against chloroquine sensitive and chloroquine resistant P. falciparum in Papua New Guinea.

Primaquine. The Chesson strain of P. vivax found in Papua New Guinea is tolerant to primaquine, requiring higher than usual dosage for radical cure.

Prophylactic Options for the British Army
1. Reducing man mosquito contact
Strict anti-mosquito discipline can greatly reduce malaria casualties. Insect repellents incorporating diethyltoluamide should be applied every 3-4 hours. Long sleeves and trousers should be worn between dusk and dawn and mosquito nets used within the limits of the tactical situation. An interesting new development is net impregnation with Permethrin, which is effective against tsetse fly and probably against malaria vectors. Trials with this agent in the military context are urgently required.

2. Chemoprophylaxis
Proguanil and proguanil-chloroquine seem ineffective. Fansidar is too toxic and may be inadequate in Papua New Guinea. Maloprim has proven efficacy against P. falciparum in Papua New Guinea but should be combined with chloroquine to give protection against non-falciparum malaria. A chloroquine-maloprim combination is recommended by the Australian Government for visitors to Papua New Guinea and by a local expert. Maloprim has toxic potential. Given twice weekly it causes agranulocytosis with a frequency of about 1:2000. Given once weekly, agranulocytosis appears to be rare, although at the expense of a slight degradation of efficacy. Proguanil plus dapsone is another possibility. This proved successful in Vietnam, but there remains a definite risk of agranulocytosis and in Papua New Guinea protection against P. vivax is uncertain. Unlike maloprim, the regimen is not of proven worth in Papua New Guinea.

On return from Papua New Guinea, a course of primaquine should be given to all men with normal levels of red cell G6PD to destroy P. vivax hypozooites.

Conclusions
The jungles of Papua New Guinea are intensely malarious. Prophylaxis is complicated by multiple resistance to anti-malarial drugs. The best prophylaxis appears to be rigorously enforced anti-mosquito discipline combined with chloroquine base 300 mg weekly plus maloprim one tablet weekly, starting one week before an exercise and continuing for 6 weeks after its end. On return, primaquine 7.5 mg thrice daily should be given to all men with normal levels of G6PD, for 14 days. As proguanil is used routinely for long-term prophylaxis in Hong Kong, this could be continued for administrative convenience, at little cost in side-effects.

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