Malaria on the Move : Ecological Considerations for the Armed Forces

Lt Col P Jaiswal*, Col S Srinivasan⁺, Col VK Mehta[#], Col A Banerjee (Retd)^{**}, Lt Col I Acharya⁺⁺

Abstract

Background: Armed forces personnel deployed in the North Eastern states of India are vulnerable to falciparum malaria. This vulnerability increases during mobilization of troops.

Methods: Epidemiological case sheet was used for recording individual movement, clinical features and laboratory investigations of each case of malaria. Immunochromotography test (ICT) or Paracheck Pf was used as a rapid test for falciparum malaria at the regimental aid post (RAP). Subsequently, a case control approach was used to ascertain whether the cases of malaria differed significantly from healthy controls in observing antimalaria measures such as the use of mosquito nets, repellants and chemoprophylaxis.

Result: Nineteen out of 623 soldiers suffered from falciparum malaria during a short period of ten days during operational mobilization. Use of mosquito nets and repellants was significantly less among the cases as compared to healthy controls. There was no significant difference among the two groups regarding compliance with chemoprophylaxis.

Conclusion: A paradigm of “malaria on the move” or “operational malaria” has been proposed.

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Key Words : Malaria; Armed Forces; Mobilization

Introduction

Malaria is a military medical problem since antiquity. Armed Forces deployed in North Eastern States bordering Myanmar (formerly Burma), particularly experience high morbidity due to malaria. Admiral Mountbatten during World War II stated that, “.....the jungles of Burma are infested with malaria mosquitoes and it presents a more redoubtable enemy than the Japanese themselves.....” [1] and during this period mepacrine drill as suppressive treatment was introduced among the Allied Troops.

Tremendous advances in malaria control measures have taken place since World War II. Despite strict implementation of antimalarial measures by the troops in the North East, sporadic cases of malignant tertian (MT) malaria, with focal outbreaks continue to occur. Recently, one such outbreak occurred in a body of troops deployed in Assam where nineteen cases of MT malaria were reported within a period of 10 days. The outbreak coincided with mobilization and a study was carried out to establish the factors responsible for the outbreak.

Material and Methods

Case definition for MT malaria was Immunochromotography test (ICT) (Paracheck Pf) positivity at Regimental Aid

Post (RAP) for all suspect cases with fever, malaise, headache etc. All cases were subsequently confirmed by peripheral blood smear.

Epidemiological case sheet filled up for each case consisted of epidemiological data like movement of individual, mobilization of troops (mass movement), clinical features, laboratory investigations, ecological factors of relevance – including mapping of malaria vectors, landscape and meteorological conditions and living and working conditions of the troops. Search for undiagnosed cases with 297 blood smears from the asymptomatic unit personnel was negative.

Subsequently, a case-control study was carried out. The 19 cases of malaria were compared with 60 healthy controls (randomly selected from the 297 smear negative persons).

Result

Of the 623 troops taking part in the exercise, 19 were admitted as cases of falciparum malaria from 22 to 30 December 2003, giving an overall incidence rate of 3% . Prior to 01 Sept 2003 the body of men were deployed in ‘A’ district of Assam. On 1st December 2003 the soldiers were mobilized and deployed in the ‘B’ district, living in an old dilapidated vacant Ice-factory. 15th December onwards the soldiers were again mobilized from ‘B’ district to ‘C’ district of Assam. This deployment was in three different phases on 15th December (strength-457), 19th December (strength-79) and 20th December (strength-87) (Table 1). On 22nd December four cases, on 23rd

*DADH, HQ 9 Inf Div, C/o 56 APO. ⁺Senior Advisor (Pathology), MH Secunderabad. [#]Senior Advisor (PSM) & ADH HQ (SC) Pune.

^{**}Associate Professor (PSM), DY Patil Medical College, Pune. ⁺⁺ Officer Commanding, SHO, Secunderabad.

December five cases, on 24th, 25th, 26th and 27th two cases each and one case each on 28th and 30th December were detected. They were all evacuated to service hospital (Table 2). On 16th January the unit de-inducted from 'C' district and returned to 'A' district. A total of 297 blood smears from the unit were examined and all the slides were negative for malarial parasites.

The mobilization took place in Assam which has thick jungle cover with heavy rainfall (over 200 cm annually). During mobilization the personal belongings including the mosquito nets were packed and the unit personnel moved in vehicles during a six hour night mobilization from 'B' to 'C' district. The troops were on chemoprophylaxis with 300 mg chloroquin weekly. As ascertained from the civil health authorities, 'B' district reports a very high incidence of malaria. Three major vectors namely *A dirus*, *A minimus* and *A fluviatilis* primarily maintain malaria in the region.

Only 31.58% of the cases used mosquito nets in the preceding two weeks as compared to 75% of healthy controls (Table 3). This difference was statistically significant (Odds Ratio = 6.50 with 95% CI between 2.10 and 20.12) and attributable fraction of not using mosquito nets leading to malaria was 84.6%. Similarly, only 42.11% of cases used repellants in the preceding two weeks as compared to 78.33% of the controls (Table 4). However, there was no significant difference in compliance with chemoprophylaxis (Table 5).

Discussion

On the basis of the probable dates of infection (average incubation period of *P falciparum* being 12 days), the cases contracted malaria at 'B' district prior to arrival at 'C' district (Table 2). The troops stayed in makeshift arrangements in an abandoned ice factory

Table 1

Incidence rate by date of induction

Date of induction	Strength	No of MT malaria cases diagnosed	Infection rate /1000
15 th Dec	457	11	24.7
19 th Dec	79	4	50.6
20 th Dec	87	4	43.49
Total	623	19	30.00

Table 2

Probable period of infection of cases

Date of diagnosis	No of patients	Date of induction in 'C' district	Probable period of infection
22 nd Dec	4	15 Dec 03	08-13 Dec 03
23 rd Dec	5	15 Dec 03	09-14 Dec 03
24 th Dec	2	15 Dec 03	10-15 Dec 03
25 th Dec	2	19 -20 Dec 03	11-17 Dec 03
26 th Dec 03	2	19 - 20 Dec 03	11-17 Dec 03
27 th Dec 03	2	20 Dec 03	13-18 Dec 03
28 th Dec 03	1	19 Dec 03	14-19 Dec 03
30 th Dec 03	1	19 Dec 03	16-21 Dec 03

adjoining thick forests, besides being involved in night patrolling in the forests and forest fringes. *A dirus* is a jungle vector in the north eastern states of India. The vector is highly anthropophilic and exophilic and malaria transmitted by it has been reported to be an occupational hazard for those who frequent the forests [2]. Due to operational requirements, troops take shelter in temporary makeshift barracks under forest cover for camouflage during the move. Toilet and bathing facilities may be situated in forested areas, exposing them during dusk and dawn to mosquito bites.

In the present outbreak as the troop strength reduced malaria incidence increased. The bulk of the unit (457 men), got de-inducted from 'B' district on 15 December, out of which 11 were affected with MT malaria giving an incidence of 24.07 per 1000. De-induction of the main body led the remaining troops physically drained and having to do away with personal protective measures existing earlier. This may be the reason why the incidence rates among troops de-inducted on 19th and 20th December were 50.6 and 43.49 per 1000 respectively, both higher than the incidence rate in the main body. This difference was not statistically significant, perhaps because of the small sample size (Table 1).

Table 3

Use of mosquito nets in the preceding 14 days

Used nets	Cases (%)	Controls (%)	Total (%)
No	13 (68.42)	15 (25)	28 (35.44)
Yes	6 (31.58)	45 (75)	51 (64.56)
Total	19 (100)	60 (100)	79 (100)

Odds Ratio = 6.5 (95% CI 2.1 to 20.12). Attributable fraction = 84.6%

Table 4

Use of repellant in past fortnight

Used repellants	Cases (%)	Controls (%)	Total (%)
No	11 (57.89)	13 (21.67)	24 (30.38)
Yes	8 (42.11)	47 (78.33)	55 (69.62)
Total	19 (100)	60 (100)	79 (100)

Odds Ratio = 8.59 (95% CI = 3.07 to 24.04). Attributable fraction = 88.4%

Table 5

Compliance with weekly chloroquin intake

Weekly chloroquin intake	Cases (%)	Controls (%)	Total (%)
No	2 (10.53)	5 (8.33)	7 (8.86)
Yes	17 (89.47)	55 (91.67)	72 (91.14)
Total	19 (100)	60 (100)	79 (100)

Odds Ratio = 1.29 (95% CI = 0.23 to 7.28)

Similar episodes have been reported from other armies. Tuck et al [3], have reported an outbreak among military personnel deployed in Sierra Leone exposed to high risk of falciparum malaria. The outbreak resulted from inadequate compliance of protection policies during operational commitments. Malaria rates coincided with increased hostilities during operations, which further compromised antimalaria precautions. Similarly Kitchener et al [4], reported an outbreak of malaria in an Australian military battalion deployed in East Timor. They used similar diagnostic strategy as the present study i.e., rapid screening with ICT testing and confirmation with thick and thin blood smear examination. The troops in this outbreak were on doxycycline prophylaxis – however they reported compromised compliance with chemoprophylaxis when their daily routine was altered during patrolling. The troops also reported difficulties in observing other antimalaria precautions such as use of mosquito nets during such night operations.

In view of malaria outbreaks among soldiers, mobilized into malarious eco-systems for operations, a paradigm of “operational malaria” or “malaria on the move” is proposed. This involve intensive pre-deployment health education which incorporate the A, B, C, D approach to malaria protection [3]. A is awareness, B is bite avoidance, C is chemoprophylaxis, and D is diagnosis (early diagnosis and aggressive curative therapy). Mosquito repellants presently in use in the Indian Armed Forces are DMP (Dimethyl phalate) oil and diethylbenzamide (Odomos) and diethyltolbutamide (Mosfree), advocated 4 to 6 hourly. Several field trials have demonstrated that the protective effect of mosquito nets can be greatly enhanced by treating them with insecticides [5]. Some research has also been carried out on impregnating clothing with insecticides to protect frontline troops against mosquito bites. Soto et al [6], have demonstrated the bite avoidance efficacy of impregnated uniforms in a small, randomized, controlled trial. The lack of significant difference in compliance with chloroquin intake between the cases and controls in the present study raises some doubt about its efficacy in the current scenario of increasing resistance to it. Despite this uncertainty, there is evidence from randomized controlled trials that chemoprophylaxis is effective against malaria [7-9]. The efficacy of Immunochromotography test (ICT) or Paracheck Pf as an effective kit for detecting plasmodium falciparum infection at the Regimental Aid Post has been strongly advocated [10]. In the present outbreak also, ICT or

Paracheck Pf was instrumental in early diagnosis and evacuation to base hospital of all suspect cases. In chloroquin resistant areas the second line of chemoprophylaxis recommended [11], is chloroquin 300 mg (weekly) together with proguanil 200 mg (daily). Due to the small sample in the present study, stratified analysis showing interaction between the two variables (nets and repellants) could not be carried out. Future studies with larger sample size could explore this issue.

Conflicts of Interest

None identified

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