RELAPSE/REINFECTION PATTERNS OF *PLASMODIUM VIVAX* INFECTION: A FOUR YEAR STUDY

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Abstract. In an endemic area relapse and reinfection in *Plasmodium vivax* cases poses serious problems for the malaria control program. We have studied the relapse/reinfection patterns of *P. vivax* infection in 26 villages of District Shahjahanpur, a malaria endemic area of UP, India for a period of four years (May, 1986 to October, 1988). All the *P. vivax* cases were given a complete course of radical treatment and were followed-up for relapse/reinfection. There were 8,914, 2,484, 1,439 and 883 *P. vivax* cases in 1986, 1987 and 1989 respectively, our of which 2,066, 141, 58 and 18 cases in the respective years showed relapse/reinfection. The maximum number of relapse/reinfection was recorded from a 47 year old male patient, who suffered from *P. vivax* infection eight times. The percentage occurrence of relapse/reinfection was much higher (70.2%) in males compared with females (29.8%). Relapses were more common among 16-30 years old patients. In conclusion it was felt that in 1986 relapse/reinfection in vivax cases was higher due to improper treatment of these cases. This situation may have occurred due to lack of awareness among the public, poor surveillance by the National Malaria Program or higher density of the vector mosquitos in the area.

INTRODUCTION

Shahjahanpur istrict, UP, India is hyper-endemic for malaria. The predominant species in *P. vivax*, constituting about 60 percent of the total malaria cases in the area. In 1983 this district experienced an epidemic leading to several deaths (Chandrahas and Sharma, 1983). Following this, in 1986 a bio-environmental control strategy for the control of malaria was launched in Dadraul PHC of this district (Sharma and Sharma, 1986). In the first year a very high incidence of malaria was recorded (Malaria Research Centre, 1987). Annual parasite incidence calculated during this year was 1,009.5. This showed that either the whole population under study suffered from malaria or a number of patients suffered from malaria more than once thus indicating the chances of relapse or reinfection in *P. vivax* cases. The latter view seemed to be valid as the slide positivity rate of the same year was only 57 (Prasad *et al,* 1991.)

Relapses in *P. vivax* are well known (Kaplan and Bernstein, 1974; Bruce-Chwatt *et al,* 1981; Rombo *et al,* 1987; Sinha *et al,* 1989). However, very limited studies are available that have been carried out in different topographical zones where different strains of parasite may be prevailing. In addition, the population of an endemic area remains at constant risk of reinfection, so that it is very difficult to differentiate between the two situations. Both situations ie relapse and reinfection are very important aspects of malaria control programs. Therefore, the data were analyzed to explore this aspect and plan the malaria control program accordingly for its more effective implementation in the area. The present communication deals with the relapse/reinfection patterns obtained during the study period (May, 1986 to October, 1989) carried out under bio-environmental control strategy.

MATERIALS AND METHODS

Study area

Dadraul Public Health Centre (PHC) is situated at about 10 km from Shahjahanpur City, with a

population of about 1 lac (1981 census). In this PHC, bio-environmental control strategy was launched in 1986. Initially only 21 villages were covered and impressive results were obtained. Encouraged by this, the entire PHC comprising 168 villages was delineated as an experimental area to demonstrate the feasibility of bio-environmental control strategy for the control of malaria of PHC level. The area is a plain and low lying terrain (rice growing area). The average annual rainfall is 6,878 mm and the temperature varies from 45.5°C maximum to 3.2°C minimum. There is an extensive canal irrigation system which originates from the well-known main Sharda canal. There are no proper roads to most of the villages, therefore it becomes very difficult to reach them. Major mosquito breeding sites are wells, ponds, pools, roadside burrow pits, waste water collections, rice field, seepage of canals, rivers etc. The inhabitants are illiterate and poor. Their main profession is agriculture.

Detection of malaria cases

In all these villages active fever survey was carried out on weekly basis. Peripheral blood smears were prepared and stained with JSB stain. Microscopic examination of all the blood smears was done for the detection of malaria parasites.

Treatment

Presumptive treatment (600 mg or 10 mg of chloroquine/kg body weight) was given after preparing the blood slides. All the malaria positive cases were given radical treatment (600 mg chloroquine and 75 mg primaquine) under the supervision of surveillance staff. Primaquine 1.25 mg/kg body weight was given divided into daily doses for 5 days. The history of all patients was recorded.

Relapse/reinfection

Since in an endemic area the chances of reinfection are very high it is very difficult to differentiate between relapse and reinfection. Therefore, a combined term, ie relapse/reinfection has been used. All the *P. vivax* cases detected from 21 villages in 1986 were followed up until October, 1989 and the new positive cases from these villages in 1987, 1988 and 1989 were also followed-up until this time. A case was taken as relapse/reinfection when the patient became positive again after complete cure of malaria following a full course of chloroquine and primaquine. The data concerning first and subsequent infections of each particular case, were noted. Only those cases who became positive after 27 days of the first infection were included as relapse/reinfection cases.

RESULTS

There were 8,914, 2,484, 1,439 and 883 cases of *P. vivax* in the years 1986, 1987, 1988 and 1989 (till October) respectively, who experienced *P. vivax* malaria infection, out of which 2,066, 141, 58 and 18 cases respectively, showed relapse/reinfection once or more than once (Table 1). The occurrence of relapse/reinfection was greater among male patients (70.2%) than females (29.8%) (Table 2). Maximum relapse/reinfection was observed in the age group of 16-30 years, followed by 6-15 and 31-45 age groups respectively (Table 3). Out of the total relapse/reinfection cases 1,371, 600, 213, 66, 25, 7 and 1 cases respectively had first, second, third, fourth, fifth, sixth and seventh relapse/reinfection during the four years. There was one 47 year old male who experienced eight consecutive infections. The interval between cure of the first infection and appearance of relapse/reinfection ranged from 27 days to more than one year.

Apart from these, there were 126 cases in 1986, 6 in 1987, 2 in 1988 and 4 in 1989 who showed infection with paroxysm even before completion of 27 days (within 14 to 26 days) after the first clinical attack.

Maximum relapse occurred between the time interval of 1-4 months of the first infection (Table 2). Yearwise percentage occurrence of relapse/reinfection (23.6%) was noticed in 1986. Thereafter, continuous decline was noticed. The respective percentage occurrence of relapse/reinfection cases in the years 1987, 1988 and 1989 was 5.7, 4 and 2. The persons who had acquired infection in the month of May showed maximum relapse/reinfection, followed by June and July.

DISCUSSION

Relapses in *P. vivax* infections are very common. In spite of a complete course of treatment with hypnozoitocidal drugs such as prima-

Table 1

Account of relapse/reinfection cases obtained in *Plasmodium vivax* cases from May, 1986 to October, 1989 in Shahjahanpur (UP) District, India.

Study year	I INF	I R/RINF	II R/RINF	III R/RINF	IV R/RINF	V R/RINF	VI R/RINF	VII R/RINF	Total reinfection/ relapse cases (%)
1986	8,914	1,221	549	200	63	25	07	01	2,066 (23.2)
1987	2,484	79	46	13	3	-	-	-	141 (5.7)
1988	1,439	54	4	-	-	-	-	-	58 (4.0)
1989	883	17	1	-	-	-	-	-	18 (2.0)

INF = Infection
R = Relapse
RINF = Reinfection

Table 2

Period and sex distribution of relapse/reinfection in *Plasmodium vivax* cases in Shahjahanpur (UP) District, India.

Time period	Total no. of relapse/reinfection cases							
	1986		1987		1988		1989	
	M	F	M	F	M	F	M	F
27-30 days	55	31*	2	0	0	2*	0	2*
1-4 months	1,016	490	71	23	13	6	3	11
5-8 months	172	72	15	8	9	5	1	1
9-12 months	160	43	11	8	9	7	0	0
12 months	61	47	1	2	3	4	0	0
Total	1,464	602	100	41	34	24	4	14

* Could be due to chloroquine resistance in *P. vivax* also.

Table 3

Age and sex distribution of relapse/reinfection in *Plasmodium vivax* cases in Shahjahanpur (UP)District, India.

Age group	Total no. of relapse/reinfection cases							
	1986		1987		1988		1989	
	M	F	M	F	M	F	M	F
0-1	-	-	-	-	-	-	0	1
2-5	89	53	1	1	4	1	1	2
6-15	386	181	10	12	6	6	1	3
16-30	546	193	55	14	16	4	2	3
31-45	365	130	30	10	6	9	-	4
45	78	45	4	4	2	4	-	1
Total	1,464	602	100	41	34	24	4	14

quine, some of the *P. vivax* patients do develop relapses. This occurs due to the presence of dormant exoerythrocytic forms, the hypnozoites in the liver. Some of the *P. vivax* strains have been shown to be poorly responsive to the action of primaquine (Roy *et al,* 1979; Bruce-Chwatt *et al,* 1981; Rombo *et al,* 1987).

Also a very high percentage of relapses/reinfections is observed from Dadraul PHC of district Shahjahanpur. The higher prevalence of reinfection/ relapse among men was probably related to higher reinfection in men because of their profession of going to the fields for earning their livelihood, whereas women of the area wear covered clothes compared to men, who most of the time wear only a small cloth around their waist. But these points do not support the findings of higher relapse/reinfection in men as there was no difference in the incidence of malaria in men and women (Prasad *et al,* 1991). This indicates that some other factors are responsible for the higher incidence of the relapse/reinfection among men. These factors may be illiteracy, lower socio-economic status, unawareness among the public towards health and hygiene, etc. After taking the presumptive treatment, when they feel a bit relieved from fever etc, the men start going to the field to work, thus they miss the radical treatment given, whereas the females generally stay at home and do not miss the drug. Our results are in accordance to those of previous workers (Shukla *et al,* 1978; Sinha *et al,* 1989), who also observed higher positivity among men. However, the percentage of the first relapse was much more higher in this area compared to other reports. This might be due to the higher endemicity in the area.

The time interval taken for the first relapse was also in accordance to previous workers ie 27 to 365 days and above (Sinha *et al,* 1989). In our study maximum relapse/reinfection occurred in patients who acquired infection in the month of May, whereas Sinha *et al* (1989) have shown it to be in September. They have pointed out that theirs is a first report of its kind from India, showing occurrence of 4 consecutive relapses, whereas we have detected 7 consecutive relapses/reinfections in a 47 years old male.

The most important points of this study are the occurrence of relapse/reinfection within one month and a drastic decline in the relapse/reinfec-

tion cases after 1986. This might be due to improper treatment of cases during high incidence of malaria. Proper treatment was given by our surveillance staff under new strategy to all the positive cases. Improvement of environment to remove breeding sites, health education etc, was also done. Our activities have helped to bring the malaria incidence and mosquito density down.

After tightening the surveillance and drug administration schedule we have observed fewer cases of relapse/reinfection in the years 1987, 1988 and 1989 compared to 1986.

On the basis of these findings it is concluded that relapse/reinfection cases occur primarily due to (i) poor surveillance of malaria cases (ii) improp er treatment (iii) unawareness and ignorance among the public (iv) less effectiveness of insecticidal technique to combat the malaria situation etc. The possibility of chloroquine resistance cannot be excluded. Relapse/reinfection *P. vivax* cases can be reduced drastically in any area if these points are given due importance in a control program.

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