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Induced Malaria in Korea

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ABSTRACT

Blood surveys on narcotic addicts in the asylums in Korea were carried out from 1959 to 1962, of 3,991 smears collected from addicts, 13 were found to be positive for *P. vivax*, 23 positive for *P. falciparum* and 1 positive for *P. malariae*. All positive cases for malaria parasites were found in the Seoul Narcotic Asylum. The possibility of transmission of malaria parasites through either mosquitos or artificial ways is discussed.

The transmission of *P. falciparum* and *P. malariae* malaria among addicts would occur probably by the indiscriminate use of congealed syringes and needles and not by the infected anopheline mosquitos.

The decreasing in number of positive cases infected with malaria parasites among addicts appeared to be due to the effectiveness of drug administration.

In addition, the blood survey on the applicants for the blood donor service in Seoul was carried out monthly from August 1961 to December 1962 and one positive smear in *P. vivax* out of 7,091 was found.

INTRODUCTION

Although *Plasmodium vivax* has been recognized as the most prevalent species of malaria parasites in Korea, quartan malaria and subtertian malaria have also been reported by several workers [*P. malariae*: Chiba and Akai (1930), Oh (1930, 1935), Kim and Kuwabara (1933), Kim (1939) Seo and Rim (1959); and *P. falciparum*: Shiiba et al. (1936), Choi (1936) Kong (1936), Kim (1939), and Seo and Rim (1959)].

During the malaria pre-eradication survey in 1959 and the passive case detection of 1960-1962 in Korea, neither *P. falciparum* nor *P. malariae* malaria parasites were found from the indigenous people; only *P. vivax*.

The author, however, saw two cases with *P. falciparum* malaria parasites in these blood surveys he conducted on the narcotic addicts in the Seoul Narcotic Asylum in 1959. From 1960 to 1962, blood survey for the malaria parasites among the addicts in all narcotic asylums in Korea were made, prior to their treatment with three days chloroquine trial (1500 mg of base) in 1960 and one single dose treatment (600 mg of base) in 1961 and 1962. Besides the above surveys, the author has tried to detect asymptomatic carriers of malaria parasites from a normal group composed of applicants for blood donor service.

The present paper reports the results of those malaria blood surveys on the narcotic addicts of the asylums in Korea, on these treatment with chloroquine in 1960 to 1962, and the result of the blood survey from August 1961 to December 1962, on the applicant blood donors for the Blood Bank of the Seoul Red Cross Hospital.

METHODS AND MATERIALS

Blood smears: Thick and thin blood smears were made for each case, mainly by the trained technicians of the Central Malaria Eradication Service, but also by either the local medical practitioners or trained nurses.

Staining method: W.H.O. standard staining method with Giemsa's solution and buffered solution (W.H.O. 1961).

Microscopic examination: Each smear was examined over at least 100 fields containing 20 white

blood cells. The species, number and stages of parasite were recorded.

Density of parasites: Parasite density is the number of the parasites per 100 microscopic fields.

Drug administration: The addicts, after taking their smears, were treated with chloroquine by the nurses in asylums, supervised by either the author or the chief medical officers in the asylums. The dosage of chloroquine was as follows:

Three days treatment: Chloroquine diphosphate (Alaren), 600 mg of base, 300 mg of 6 hours later; 300 mg daily for the next 2 days. Total 1500 mg of base.

A single treatment: Chloroquine diphosphate (Alaren), 600 mg of base, single dose.

NARCOTIC ASYLUMS IN KOREA

In Korea, the 9 narcotic asylums, run by the Government, are located in Seoul, Inchon, Kwangju, Taegu, Pusan, Chunchon, Taejun, Chungju, and Chunju. Most asylums can hold between 10 and 20 addicts except Seoul Narcotic Asylum which can admit about 150.

In the Seoul Narcotic Asylum, the total admission of addicts in the past 5 years (1955-1959) was 6,596, the age distribution being mainly between 20 and 60 years of age. The frequency of the admission of the same individual was as follows: once 3,339 cases; twice=1,442 cases; three times=999 cases; four times=506 cases; five times=193 cases; six times=62 cases; seven times or more=28 cases (Total=6,569 cases).

In Korea, the estimated total number of the narcotic addicts may be about 5,000, most of them occurring in Seoul. The principal narcotic drug is Heroin, and is obtained secret by. The drugs are used indiscriminately and administered by injection with unsterilized syringes and needles contaminated with congealed blood, so that the risk of transmission of various disease organisms including malaria is probably higher among the narcotic addicts than the normal population.

RESULTS

1. The preliminary blood survey

In 1959, a blood survey was carried out three times in the Seoul Narcotic Asylum during August, November and December and once in the Inchnon Narcotic Asylum in November (Table 1). Two smears out of 323 were postive for *P. falciparum* from the Seoul Narcotic Asylum; 6 smears from the Inchon Narcotic Asylum were negative. No *vivax* were found. The two positive smears for *P. falciparum*, taken in November and December (Table 3), were obtained from male addicts aged 39 and 40. The density of parasites was 25 and 50, respectively, parasites were ring forms and gametocytes.

2. The blood survey

1) In 1960, the blood survey was carried out monthly from all addicts admited to the narcotic asylums. 1,630 smears were colleted (Table 1, 2), of which 1,205 smears were from the addicts at the Seoul Asylum; 16 of these smears were positive for *P. falciparum* and 3 for *P. vivax*. The positive smears for *P. falciparum* were found in February, March, April, May, August, October, and December. The density of parasitses was mostly between 10 and 20, although 3 *P. falciparum* smears, 2,000; 1,900 and 200 were found. Counts were 10, 10 and 15 in the positive *P. vivax* smears. *P. falciparum* parasites were ringforms and gametocytes; trophozoites and gametocytes in *P. vivax*. The sex of positive cases was as follows: all male in *P. falciparum*; and 2 male and 1 female in *P. vivax*.

2) In 1961, the survey was done only in the Seoul Asylum. Out of 1,442 smears collected from the Asylnm, 5 positive for *P. falciparum* and 10 for *P. vivax* were found (Table 1, 3). The *falciparum* smears were found in January, April, July and October. The density of parasites for *P. falciparum* was between 50 and 100, except one case with 1,500; for *P. vivax* between 50 and 200. *P. falciparum* parasites were mainly ringforms and gametocytes. *P. vivax* smears contained trophozoites, schizonts and gametocytes. *Falciparum* positive cases consisted of 4 males and 1 female, and 6 males and 4 females composed the 10 *vivax* cases.

3) In 1962, survey was made only in the Seoul Asylum. out of 590 smears collected, only one case of *P. malariae* was found (Table 1, 3). The case was a female aged 58 and the density of the para-

Table 1. Blood smears from Seoul narcotic asylums

Year	1959						1960						1961						1962					
Sex	M		F		T		M		F		T		M		F		T		M		F		T	
Month / No	No	P	No	P	No	P	No	P	No	P	No	P	No	P	No	P	No	P	No	P	No	P	No	P
January	—		—		—		62	0	29	0	91	0	81	2	40	0	121	2	48	0	23	0	71	0
February	—		—		—		69	2	29	0	98	2	68	0	32	0	100	0	81	0	48	0	129	0
March	—		—		—		80	4	41	0	121	4	354	0	35	0	189	0	41	0	25	0	66	0
April	—		—		—		48	3	42	0	90	3	82	1	40	0	122	1	19	0	9	0	28	0
May	—		—		—		60	5	23	0	89	5	86	0	39	0	125	0	51	0	16	1	67	1
June	—		—		—		59	0	26	0	85	0	42	1	36	0	78	1	40	0	25	0	65	0
July	—		—		—		68	0	21	0	89	0	190	5	64	0	254	5	30	0	14	0	44	0
August	74	0	32	0	106	0	90	1	32	0	122	1	75	1	41	2	116	3	—		—		—	
September	—		—		—		72	0	36	0	108	0	84	1	53	1	137	2	32	0	20	0	52	0
October	—		—		—		72	1	35	0	107	1	40	0	23	1	63	1	36	0	32	0	68	0
November	70	1	35	0	105	1	81	0	24	0	105	0	20	0	9	0	29	0	—		—		—	
December	77	1	35	0	112	1	64	2	41	1	105	3	82	0	26	0	108	0	—		—		—	
Total	221	2	102	0	323	2	826	18	379	1	1205	19	1004	11	438	4	1442	10	378	0	212	1	590	1

P.=Positive in malaria parasites M=Male F=Female T=Total

Table 2. Blood smears from Korean narcotic asylum outside Seoul 1960

Locality	Inchon			Chunchon			Taejun			Chungju			Pusan			Taegu			Kwangju			Chunju		
Month / Sex	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
January	3	5	8	0	1	1	—	—	—	—	—	—	1	0	1	4	0	4	4	1	1	0	—	—
February	3	11	14	0	2	2	1	2	3	1	0	1	1	1	2	2	0	2	3	0	3	—	—	—
March	3	8	11	—	—	—	—	—	—	2	0	2	0	1	1	4	0	4	3	0	3	—	—	—
April	10	12	22	7	0	7	3	0	3	1	0	1	3	4	7	4	0	4	8	0	8	2	0	2
May	8	16	24	8	6	14	3	2	4	2	0	2	5	0	6	5	2	7	4	0	4	5	0	5
June	7	16	23	8	0	8	2	0	2	1	0	1	5	6	11	3	2	5	3	1	4	5	2	7
July	15	9	24	7	3	10	—	—	—	—	—	—	3	2	5	4	3	7	1	0	1	2	0	2
August	0	6	6	3	0	3	—	—	—	—	—	—	—	—	—	—	—	—	0	2	2	0	3	3
September	5	6	11	4	1	5	1	6	7	2	1	3	0	1	1	1	0	1	1	0	1	2	0	2
October	5	6	11	4	1	5	1	0	1	2	0	2	1	2	3	1	0	1	0	6	6	2	1	3
November	5	10	15	—	—	—	1	6	7	0	7	7	0	1	1	0	1	1	0	1	1	0	1	1
December	3	6	9	2	1	3	1	0	1	—	—	—	3	0	3	0	1	1	1	0	1	1	0	1
Total	47	111	178	43	15	58	12	16	28	15	1	16	22	25	47	28	9	37	25	10	35	19	7	26

sites was 150 with all stages.

3. Drug administration

In 1960,all addicts admitted to the asylums received the presumptive treatment with chloroquine (1500 mg of base) for three days after taking blood smears. In 1961 and 1962 the addicts admitted to the Seoul asylum were treated with chlorquine(600 mg of base), single dose.

The total amount of tablets of chloroquine (Alaren) (300 mg of base per tablet) administered was as follows: in 1960, 8,150 tablets and in 1961 and 1962, 4,064 tablets.

After the administration of the drug, some addicts complained of bitterness, nausea, vomiting, dizziness, epigastrical uneasiness, abdominal pain, and so on. Some refused to take the drug due to difficulty of swallowing the tablets. The incidence of *P. falciparum* and *P. vivax*, was apparently recduced to zero after the drug administration with chloroquine to the addicts in the Seoul

Table 3. Positive cases showing malarial parasites from Seoul narcotic asylum

Year	Month	No. of case	Age	Sex	Malaria parasites							
					P.v.	P.f.	P.m.	Steages				Density
								P	T	S	C	
1959	Nov.	1	40	Male	—	X	—	X	—	—	X	25
	Dec.	2	39	//	—	X	—	X	—	—	X	50
1960	Feb.	3	30	Male	—	X	—	—	—	—	X	30
	//	4	22	//	—	X	—	X	—	—	X	20
	Mar.	5	36	//	—	X	—	—	—	—	X	10
	//	6	30	//	—	X	—	—	—	—	X	10
	//	7	30	//	—	X	—	X	—	—	X	60
	//	8	33	//	—	X	—	—	—	—	X	20
	Apr.	9	39	//	X	—	—	—	—	—	X	10
	//	10	45	//	—	X	—	X	—	—	X	2,000
	//	11	47	//	—	X	—	X	—	—	X	1,900
	May	12	45	//	—	X	—	X	—	—	X	90
	//	13	30	//	—	X	—	X	—	—	X	200
	//	14	46	//	—	X	—	—	—	—	X	12
	//	15	45	//	—	X	—	X	—	—	X	10
	//	16	32	//	—	X	—	X	—	—	—	70
	Aug.	17	49	//	—	X	—	X	—	—	X	40
	Oct.	18	39	//	—	X	—	—	—	—	X	40
	Dec.	19	44	//	—	X	—	—	—	—	X	20
	//	20	46	Female	X	—	—	—	X	—	X	10
	//	21	45	Male	X	—	—	—	X	—	X	15
1961	Jan.	22	42	male	—	X	—	X	—	—	X	80
	//	23	34	//	—	X	—	X	—	—	X	1,500
	Apr.	24	36	//	—	X	—	—	—	—	X	100
	Jun.	25	48	//	X	—	—	X	X	X	—	100
	Jul.	26	26	//	X	—	—	—	X	X	X	200
	//	27	57	//	X	—	—	—	—	—	X	100
	//	28	32	//	X	—	—	—	X	X	—	150
	//	29	36	//	X	—	—	—	—	—	X	100
	//	20	28	//	—	X	—	X	—	—	X	70
	Aug.	31	32	Female	X	—	—	—	X	X	X	140
	//	32	29	//	X	—	—	—	X	X	—	170
	//	33	33	male	X	—	—	X	X	—	—	40
	Sep.	34	31	Female	X	—	—	—	X	X	—	50
	//	35	57	Male	X	—	—	—	—	—	X	80
	Oct.	36	24	Female	—	X	—	X	—	—	X	50
1962	May	37	58	Female	—	—	X	X	X	X	X	150

Note; P.v.=Plasmodium vivox, P.f.=P. falciparum. P.m.=P. malariaes. R.=ring forms, T.=trophotoites. S=schizonts, G.=gametocytes

Asylum.

The percentage of positivve cases is shown as below:

Year	1960	1961	1961
Number of smears examined	1,205	1,442	590
Positive *P. falciparum*	16(1.32%)	5(0.35%)	0(0%)
Positive *P. vivax*	3(0.25%)	10(0.69%)	0(0%)
Total	19(1.58%)	15(1.04%)	0(0%)

Among those smears examined, some were coll-

ected from the same addicts returned to the asylum, but no positive smears were collected from the same addicts.

4. Blood survey on the applicants for the blood donor service

Out of total 7,091 smears collected from the applicants for blood donor service with the Blood Bank of the Seoul Red Cross Hospital monthly from August 1961 to October 1962, only one positive smears for *P. vivax* was found. Most applicants were poor people living in Seoul City but some came from the vicinity of the City and the rural areas.

DISCUSSION

1. Plasmodium vivax

Although the incidence of *P. vivax* malaria is said to be disappearing in Korea after the Korean War 1950-1951, many endemic foci areas of malaria have been found during the malaria pre-eradication survey in 1959 and passive case detection during 1960—1962. All malaria cases from the indigenous people were due to *P. vivax*. Seo and Rim (1959) reported the first case of *P. vivax* from narcotic addicts in Korea, and Geiger (1932), Nickum (1933), Helperm (1934), Hoshisaki et al. (1935), and others reported *P. vivax* malaria parasites from narcotic addicts in other countries.

Ten positive *vivax* cases in the present study were found during June and September: the malaria transmission season, only 3 cases being found in April and December when transmission was not actually taking place. Since many new *P. vivax* cases have been reported from the local practitioners and the voluntary collaborators during the passive case detection in Korea, of which some were reported from Seoul, and follow-up study on those positive cases from addicts and blood donors were not able to carry out, it is difficult to prove whether these positive cases of *P. vivax* found among addicts were transmitted by the indiscriminate use of congealed syringes and needles or by infected anopheline mosquitos, and whether the positive case of *P. vivax* from applicant blood donors was indegenous or relapse.

2. Plasmodium falciparum

In Korea, Shiiba et al. (1936), Choi (1936), and Kong (1936) reported the first cases of *P. falciparum* malaria. Kim (1939) reported a case of mixed infection with *P. falciparum* and *P. malariae* from narcotic addicts.

During the malaria pre-eradication survey in 1959 and passive case detection during 1960-1962 in Korea, no cases of *P. falciparum* malaria were found among the indigenous people. However, Seo and Rim (1959) reported 85 cases of *P. falciparum* among the addicts in the Seoul Narcotic Asylum. In several publications on malaria cases found among narcotic addicts it has been emphasized that the transmission of *P. falciparum* was due to the indiscriminate use of unsterilized syringes and needles containing congealed blood and therefore should be considered to be artificial (Biggam (1929), Nickum (1933), Helperm (1934), Kim (1939), Hoshisaki et al. (1939), Lim and Lee (1936), Seo and Rim (1959) and others).

Kobayashi (1939) stated that the temperature and the climate in Korea would be suitable for the development of the *falciparum* parasites only during the summer months. Faust (1955), however, states that *falciparum* infection is essentially confined to tropical and subtropical regions and has never become established in areas where there are long cold seasons. Detinova(1962) quoted Nikolaev's statement that the sporogony of *P. vivax* takes place at a temperature not lower than 16°C. and of *P. falciparum* at a temperature of not less than 18°C. According to the meteorological data gathered during the last 50 years the average temperature was above 15°C. in the period from June till September (Fig. 1). The number of days with a temperature higher than 25°C. was 1.3 days in June, 13.8 days in July, 19.0 days in August, and 1.0 days in September in Seoul (Central Meteorological Observatory, 1956). Although the temperature in July and August may be suitable for *P. falciparum* sporogony in anopheline mosquitos in Korea, it appears that the sporogony of *P. falciparum* would not be successful due to the presence of long cold winter months and the shortness of the warm

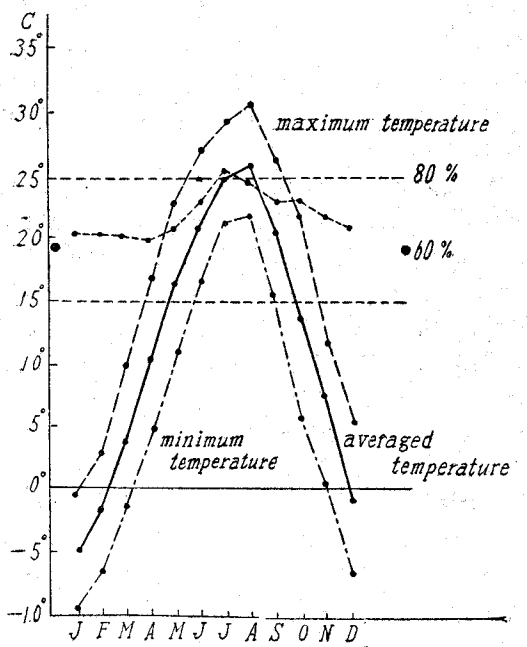

Fig. 1. Temperature and relative humidity in Seoul (50 years average 1904~54).

summer months in Korea. Although *Anopheles sinensis* has been proved experimentally to be a vector of *P. vivax* and one female *sinensis* among about 5,000 specimens dissected was found to have sprozoites in the salivary glands, no anophelines have been to be a vector of *P. falciparum* [(Kobayashi (1939), Whang (1962)], Although six species of anophelines including *A. sinensis*, *A. sineroides*, *A. koreicus* *A. koreicus edwardsi*, *A. lesteri* and *A. lindesayi japonicus* were collected during the entomological study in 1960 and 1961, all the species were found to be zoophilic (Whang, 1962).

Although most of the *falciparum* cases found in this study had between 1 and 2 gametocytes per 200 leucocytes and could therefore have infected anopheline mosquitos according Darling and Green (Strong, 1943), these *falciparum* cases were found during the winter months when the mosquitos are absent.

In the opinion of the author the *falciparum* cases in this study are strongly suspected to be due to artificial transmission and summarizing the following reasons should be mentioned:

1) These cases were detected in the winter months when the mosquitos does not breed.
2) These cases were all narcotic addicts who had used indiscriminately with unsterilized syringes and needles containing congealed blood.
3) Apart from the narcotic addicts, no evidence of transmission of *P. falciparum* malaria was found among the indigenous people in Korea.

3. Plasmodium malariae

Chiba and Akai (1930) reported 14 cases infected with *P. malariae* from the indigenous pepole in Susan-kun, Chungchong Namdo, Korea and Oh (1930, 1935) also reported 4 cases of and 1 case *P. malariae*, respectively, among the indigenous people in the same province (Polyung-kun and Yesan-kun, Chungchong Namdo). Kim and Kuwabara (1933) reported 5 cases infected with *P. malariae* parasites found among addicts in Kyonggido Narcotic Asylum (now the Seoul Narcotic Asylum). Kim (1939) reported a case of mixed infection with *P. falciparum* and *P. malariae* from the Asylum. Seo and Rim (1959) reported 16 cases of *P. malariae* found from addicts in the Seoul Narcotic Asylum.

The follow-up study on the female case of *P. malariae* in the present study was carried out immediately after finding the malaria parasites in the smear. However, the information obtained from her could not be reliable. Those cases reported by Chiba et al (1930) and Oh (1930, 1935) would be suspected to be indigenous, although no anophelines were proved to be a vector of *P. malariae*. Up to now since 1935, all cases of *P. malariae* reported in Korea were found among addicts, and no cases of *P. malariae* have been found among the smears collected from the indigenous people during the pre-eradication survey in 1959 and passive case detection during 1960–1962 in Korea. Although it could not be appreciated whether she was infected by the indiscriminate use of contaminated syringes and needles of congealed blood or by infected anophelines, she appeared to be transmitted by the artificial way.

4. Drug adiministration

In order to eliminate the danger of transmission of *P. falciparum* from addicts to addicts or to

indigenous people, the presumptive treatment with chloroquine was started in the asylums since 1960. The averaged frequency of admission of the addicts in the Seoul Asylum during 1955–1959 was 1.94 per year, and obstinate addicts were likely to be admitted more than twice in one year. Therefore, the presumptive treatment with chloroquine would cover probably most of the obstinate addicts since 1960 upto October 1962.

The number of positive cases infected with *P. falciparum* among addicts in the Seoul Asylum has decreased in the period 1960–1962 following the antimalarial administration, suggestive that the treatment was highly effective. However, follow-up of the *falciparum* cases was attempted, most addicts gave unreliable information with regards to their names and addresses, and few could be traced or recognized again.

5. Blood survey on the applicant for blood donor service

Since Woolsey (1911) reported the first cases of malaria infection transmitted by blood transfusion, many workers have since reported the source of infective malaria and its dangers. In Korea, there is no conclusive evidence of transfusion malaria, although information from local practitioner and malaria patients suggests that it might occur.

On referring to Carrescia (1960) finding that in heavily infected blood *P. vivax* remained infective for 5 days and *P. malariae* for 11 days, of storage and to Marcos (1961) suggesting that all blood suspected of harbouring malaria parasites should be kept for at least 12 days near zero temperature before transfusion, all blood stored for 3 days before use in Korea, as Won. Chief of Seoul Blood Bank Service mentioned (1962), would be suspected to harbour malaria parasites. Therefore, it is suggested that in any areas where the malaria eradication is not completed, all blood should be carefully checked for malaria parasites before transfusion and all blood must be stored for enough duration to kill all malaria parasites. And also the recipient of blood transfusion should be taken the presumptive treatment with chloroquine either for three days or a single dose. Then, the risk of the transmission of malaria parasites by transufusion of blood would be minimized.

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