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OASIS MALARIA AND METHODS OF ERADICATION

by

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EPIDEMIOLOGY

In studying oasis malaria, reference should be made to the "Man, mosquito, parasite complex" with special concentration on certain points that might be considered peculiar to an oasis. The classical definition of an oasis is that it is a depression in a desert area which leads to accumulation of water. Dependent upon the amount of available water, a certain number of human population settles either temporarily or permanently in or around such a depression. The usual source of water for permanent settlement is from deep wells (artesian wells) or springs. Another factor that governs the number of settling people is the facility of availability of water. Where the depression is deep and the level of water is near, there will be a continuous flow of water from a dug well without need for any mechanical means. Such settlers are usually not clever farmers, thus much unused water will be available. Besides, drainage is inadequate and the irrigation canals are badly constructed, and so extensive sheets of surface or seepage water accumulate. This will invite an extensive breeding of mosquitoes with only a comparatively small population who will be frequently bitten and thus highly exposed to infection. Such settlers are usually primitive and contented. They live on cereals, and many of them consume a lot of rice and their income depends mainly on dates. Neither the cereals nor the palms need much water and the rice cultivation means an accumulation of pond-like water in the field. Thus water is permanently accumulating either unused in winter, spring and fall, or in the rice fields in summer.

In the season of the date crop, which is usually the fall, many of them sometimes leave their houses to build temporary huts in the palm groves. They are thus more exposed to infection in such huts if their houses were sprayed. Moreover, when their summer temperature is high, many people either sleep outside in the open courtyard or on the top of their roofs exposed to outdoor biting of mosquitoes. The means of transport for shipping of the date crop is either on camel back or by means of trucks. This also has a bearing on importation both of mosquitoes and malaria. Bedouins from the surrounding desert and caravans also visit such settlements, either supplying them with vectors or contracting malaria from the locality, thus starting a difficult problem in malaria eradication programmes.

The longevity of the mosquito and the efficiency of the vector determine the prevalence and season of malaria. The oasis usually has a continental climate, very hot in summer days and very cold in winter nights. Wherever an optimum temperature coincides with sufficient humidity, a malaria outbreak develops. During the very hot summer with low humidity, the mosquito development is fast but its longevity is short so the transmission is interrupted. The cold winter, on the other hand, delays mosquito breeding and reduces or even stops parasite development. As for the vector efficiency, high mosquito density of even a poor vector like A.pharoensis or A.sergenti, is able to cause much malaria as e.g. the Egyptian Oases. In the case of an efficient vector such as A.stephensi very high malaria incidence is expected, as occurs in the Katif Oasis of Saudi Arabia.

The size of an oasis varies from a very small population settling around a well to a very large number of big villages e.g. the Al Hassa Oasis of Saudi Arabia whose population is about 100,000. This obviously depends on the number of wells and the available cultivable land. It is worthy of mention here that in some countries such as in the Egyptian Province of the U.A.R., there is a project for the expansion of two of these oases to utilize about ten times as much as the present cultivated land by increasing the number of wells. In such cases, it is vital first to eradicate malaria from the local population, second to guard against importation of malaria with the new settlers and, last but not least, to limit and control the water supply, build proper irrigation ditches and make proper drainage systems to keep the population healthy and prosperous.

Lastly the sparse distribution of the villages in an oasis is an advantage sometimes, rendering them suitable places for malaria research and trials of the different methods used in eradication. On the other hand, this same property is a disadvantage in eradication and control operations, especially as regards supervision and transport.

METHODS OF ERADICATION

In the Egyptian territory of the U.A.R. we have more than 40,000 people living in four oases that lie to the west of the Nile Valley. They were well known to be very malarious since the very old history. They were used as caravan stops for the routes that pass between the Sudan, Egypt and North Africa. The vector species is mainly A.sergenti. There exists also, in the three southern oases only, A.pharoensis, which is the main vector in the rest of Egypt. However it does not appear to be important in the

oases, as most of the specimens were collected from stables, and more than 95% of the blood meals tested were found to contain ox blood. Besides, after the eradication of A.sergenti from Dakhla and Kharga Oases (Madwar and Shawarby), rice cultivation was greatly increased. Consequently A.pharoensis bred extensively and despite a parasite rate of 2.5% during that year in Kharga, malaria incidence steadily went lower and disappeared in 1950 without any control or surveillance effort.

In these cases we took the opportunity of both their malariousness and isolation to undertake and evaluate the different methods used in malaria control.

In Dakhla and Kharga we tried the use of larviciding and in fact we were aiming at a vector eradication, and after a tremendous effort lasting for three years we presumably succeeded in eradicating A.sergenti but not A.pharoensis or A.multicolor. Re-infestation with A.sergenti took place two years later and the species established itself in Dakhla, and in another year in Kharga also. The effort and the expenditure were not completely wasted as malaria dropped dramatically (Table I). Since 1950 many new wells were dug and nowadays there is an extensive project for land reclamation and well digging. Luckily enough the incidence of malaria has not increased and an attempt towards complete eradication by surveillance is being made.

In 1950, a residual spraying programme was undertaken at Siwa Oasis to try malaria eradication and compare the results and expenditure. In spite of the persistence of A.sergenti, the only local vector, malaria has also almost disappeared as shown in Table II. The expenditure in this campaign was about one-tenth of the preceding one. The cost per capita for larviciding was calculated to be about 2.2 Egyptian Pounds compared to only about 0.2 for the residual spraying. Moreover the effort spent was much less. Surveillance is also being introduced to reach a complete malaria eradication.

In 1955 and 1958 mass drug distribution was evaluated in Bahareya Oasis. Two drugs were tried namely Camoprim (camoquine 0.15 + primaquine 0.01) in 1955 and Pyremethamine (daraprim) in 1958. The isolated villages, Harra and Heiz were chosen for drug distribution. They lie about 30 kms. apart. Their population is about 650 and 350 respectively. Two other villages, viz. Bawiti and Zabou, 18 kms. from Harra, were kept as controls.

Camoprim was distributed to everybody in Harra in February 1955 at a dose of three tablets for the adult above twelve years of age, two down to eight years and one until four years of age and half a tablet below that. The whole dose was given at bed-time by our staff. The drug has a bitter taste that was rejected by children and infants. Side effects included nausea, giddiness and headache that lasted for a few hours. Eight doses were given at fortnightly intervals during February and March, with the idea of radically curing the disease during the off-season to that by the time transmission starts, all the parasite reservoirs would have been eliminated. Results are given in Tables III, IV and V. The condition of Malaria was surveyed during the latter part of 1954 in Harra village (Table VI). It might be noted that the three common species of plasmodium occur in this village with a preponderance of P.malariae up to September and of P.falciparum

during October and November; the peak for both lies in November. In January 1955 a pre-treatment survey showed an average parasite rate of 9.7% (Table V) and the higher percentages occurred in the lowest age groups. The post-treatment survey done at the end of March showed an appreciable drop to an average rate of 2.3%. However, it did not eliminate the reservoir as was expected. Comparison of the months of January and April in the control village (Bawiti, Table V) also points to a decrease of the parasite rate from 12.1% to 8.9%. Nevertheless, statistical study of such differences signifies the effectiveness of the drug. The same schedule of drug distribution was followed during September and October of the same year. In that case the effectiveness of the drug was much more apparent as the parasite rate dropped from 4.3% to 0.8% and at the same time it was the opposite in the control village where it rose from 9.2% to 13.5%. The latter rise was especially prominent in the incidence of P.falciparum. However, in October 1956, the average parasite rate was 15% out of 288 films examined.

It might thus be concluded that Camoprim is an effective suppressive but it was unable to eliminate the reservoir in the given schedule, and further research as regards adjustment of the interval and probably the dosage, is needed.

In the case of Daraprim, a trial was made in 1958 to test the residual effect of the drug in the two villages of Harra and Heiz taking the villages of Zabou as control. Daraprim 25 mgm. tablets were distributed to all the population of Harra once every month starting from the 22nd of June until the 22nd of October. Children up to seven years were given 1/4 tablet and between seven-twelve half a tablet. In Heiz two doses only were given, the first on the 22nd of June and the second on the 9th of August so that on the 22nd of September the effect of the drug would have lasted for about forty-five days. Blood collection from almost all the population was finished in about two-three days. The positive cases were treated with one dose of simple camoquine in all these villages. The results of blood examination starting from May to November inclusive is given for each age group in Tables VI and A-D.

It might be noted that though the number of infants (Table VI A) is rather small in all villages, yet it shows that the incidence of malaria among them was highest during September, October and November. In the case of young children (Table VI B) Harra, which received monthly daraprim, had the lowest incidence while Heiz maintained the low incidence during July and August only. In September, i.e. about forty-five days after the second daraprim dose, the malaria percentage was very close to that of Zabou, the control village. The older children in the next table (VI C) showed a very similar picture. In the population above twelve years, malaria showed generally a low percentage in all these villages, much more so in Harra.

It may thus be concluded that the drug used in that way appears to be a comparatively effective suppressive. It appears also that its effect does not last for forty-five days.

It is worth while to mention also that in Harra there were in all twenty-seven cases of malaria (5 vivax, 8 falciparum and 14 quartan) and eighty-eight cases in Zabou (3 vivax, 71 falciparum and 14 quartan). All these cases as mentioned above were treated with Camoquine from 22nd June onwards and were apparently followed during the period of the experiment from one to five months. Only one of the fourteen quartan cases of Harra had a second attack during the period. On the other hand, fourteen of the seventy-one cases of falciparum of Zabou had two or more attacks.

References

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TABLE I

Malaria in Kharga and Dakhla Oases, 1945-1958

Year	Dakhla			Kharga		
	No. of films examined	No. pos.	% pos.	No. of films examined	No. pos.	% pos.
1945	961	141	14.7	501	32	6.3
1946	6,847	946	13.8	2,532	208	8.2
1947	3,639	39	1.1	1,720	62	3.6
1948	1,968	6	0.3	1,372	32	2.3
1949	1,935	11	0.6	1,191	16	1.3
1950	3,878	51	1.3	3,880	0	0
1951	2,128	46	2.2	4,512	5	0.1
1952	5,577	102	1.8	4,153	3	0.07
1953	7,212	15	0.2	5,494	0	0
1954	7,733	2	0.02	5,627	1	0.02
1955	1,405	0	0	623	0	0
1956	1,316	1	0.07	692	0	0
1957	1,771	1	0.06	795	0	0
1958	2,056	0	0	871	0	0

Note: The preliminary survey of 1945 started in November and lasted one month.
- A larviciding campaign was carried out in both between 1946 and 1948.
- Dakhla to 1951 spray.
In October 1951, houses of Dakhla were spray-painted with BHC.

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TABLE II

Malaria in Siwa Oasis, 1950-1958

Year	No. of films examined	No. positive	% Pos.	Spray Painting
1950	541	97	18.8	-(survey)
1951	3,776	276	7,3	4 times
1952	4,583	71	1.5	twice
1953	1,543	15	0.9	twice
1954	853	7	0.8	once
1955	797	0	0	-
1956	793	3	0.4	-
1957	678	11	1.6	-
1958	899	7	0.8	-

TABLE III - Malaria Survey (Harra Village) 1954

Age Group	July					August					September					October					November				
	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%
0 - 1	6	0	0	0		4	0	0	0		2	0	0	0		11	0	0	0		6	0	3	0	
2 - 4	32	0	0	4		14	0	0	2		3	0	0	1		80	2	4	9		45	0	10	9	
5 -12	30	0	0	3		28	0	0	0		13	0	0	5		38	0	0	1		38	0	3	5	
12 +	98	0	0	3		98	1	0	0		28	0	0	1		185	1	0	3		161	0	1	1	
Total	166	0	0	10	6	144	1	0	2	2.1	46	0	0	7	15.1	314	4	4	14	4.4	250	0	17	15	12.8

TABLE IV - Malaria Survey (Harra Village) 1955 (Camoprim Mass Distribution)

	January					End of March (after Camoprim I)					June					Sept. (before Camoprim II)					End of Oct. (After Camoprim II)				
0 - 1	23	2	1	4	34	-	-	-	-	-	10	0	0	0		11	0	1	0	9.0	5	0	0	0	0
2 - 4	86	1	5	7	15	90	0	0	5	5.5	49	0	0	7	14	35	0	0	2	5.7	19	0	0	0	0
5 - 12	124	0	10	9	13.3	93	0	2	4	6.4	34	0	0	1	3	56	1	3	1	9.0	35	0	2	0	5.7
12 +	263	1	2	8	4.1	330	0	0	1	0.3	107	0	0	1	0.4	176	0	3	1	2.2	168	0	0	0	0
Total	514	4	18	28	9.7	313	0	2	10	2.3	200	0	0	9	4.5	278	1	7	4	4.3	227	0	2	0	0.8

TABLE V - Malaria in Control Village (Bawiti) 1955

AGE GROUP	January					April					June					September					November				
	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%	Tot. Sm.	V.	F.	M.	%
0 - 1	14	0	4	3	50	70	0	2	3	7.1	39	0	3	0	7.6	26	1	6	5	46	17	1	1	1	18
2 - 4	60	0	7	15	36.6	258	0	2	31	12.8	106	0	1	12	12.2	72	1	10	7	25	132	1	48	2	38.6
5 - 12	82	0	0	14	17.0	233	0	0	14	6.0	125	0	1	5	4.8	216	1	23	8	14.8	170	0	38	6	26
12 +	324	0	1	14	3.3	33	0	0	1	3.3	372	0	0	2	0.5	467	0	7	3	2.1	499	1	8	4	2.6
Total	480	0	12	46	12.1	594	0	4	49	8.9	642	0	5	19	3.7	781	3	46	23	4.2	818	3	95	13	13.5

TABLE VI: Daraprim Experiment

(A) 0-1 age group

Month	Harra					Heiz					Zabou				
	Sm.	V.	F.	Q	%	Sm.	V.	F.	Q	%	Sm.	V.	F.	Q	%
May	32	0	1	0	3.1	12	0	0	0	0	18	0	0	1	5.5
June	29	0	0	0	0	15	0	0	0	0	21	0	0	0	0
July	31	0	0	0	0	16	0	0	0	0	17	0	0	0	0
Aug.	31	0	0	0	0	16	0	0	0	0	16	0	0	0	0
Sept.	32	0	0	0	0	26	1	0	0	3.8	22	0	0	1	4.5
Oct.	33	0	0	0	0	21	0	0	0	0	22	0	2	0	9.0
Nov.	35	0	0	0	0	24	0	0	0	0	19	0	1	0	5.2

(B) 2-4 age group

May	90	0	1	0	1.1	54	0	1	1	3.7	64	0	1	4	7.8
June	97	0	1	1	1.9	57	0	3	3	10.5	64	0	0	0	0
July	99	0	1	0	1.0	57	0	1	0	1.7	65	1	1	0	3.0
Aug.	96	0	0	1	0.9	54	0	0	0	0	67	0	4	1	7.1
Sept.	93	1	2	0	3.2	44	0	4	0	9.0	58	0	6	0	10.3
Oct.	87	1	0	0	1.1	55	0	2	0	3.6	61	0	6	0	9.8
Nov.	86	0	0	0	0	49	0	5	0	10.2	60	1	10	0	18.3

(C) 5-12 age group

May	140	0	0	4	2.8	92	0	0	10	11.0	120	0	0	0	0
June	143	0	3	4	4.9	90	0	0	7	7.7	122	0	1	1	1.6
July	143	0	0	0	0	90	0	0	0	0	119	0	2	1	2.5
Aug.	148	0	0	0	0	91	0	0	0	0	119	0	3	1	3.3
Sept.	144	0	0	1	0.7	90	0	4	0	4.4	112	1	3	1	4.4
Oct.	147	0	0	0	0	85	0	3	0	3.5	123	0	12	1	10.5
Nov.	140	0	0	1	0.7	81	0	5	0	6.1	116	0	13	0	11.2

(D) 12 + age group

May	376	0	0	2	0.5	209	0	0	4	1.9	395	0	0	3	0.7
June	352	0	0	2	0.5	193	0	1	5	3.6	390	0	0	1	0.2
July	346	0	0	1	0.3	195	0	0	0	0	411	0	2	1	0.7
Aug.	371	0	0	0	0	210	1	0	0	0.4	410	0	3	0	0.7
Sept.	346	3	0	1	1.1	194	0	0	0	0	386	2	5	2	2.3
Oct.	357	0	0	0	0	188	0	1	0	0.5	388	0	7	0	1.8
Nov.	337	0	0	0	0	197	0	3	0	1.5	358	0	3	0	0.7