

Epidemiology of Bancroftian Filariasis in Nagate and Abumize Villages, Nagasaki Prefecture, Especially in Relation to Vector Mosquitoes.

4. Filariasis eradication experiment by the control of vector mosquitoes.*

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ABSTRACT : In Nagate Village where bancroftian microfilarial incidence in 1961 had been 14.0%, control works for the major vector, *Culex pipiens pallens*, have been carried out. Since 1962 residual spraying was made once a year usually on mid-June prior to the breeding out of the vector mosquito and larvicide applications were continued once a week throughout the breeding season. By the end of 1965 nearly half of initial carriers became negative and clear decrease in microfilarial count was found. From the reductions by the present time in the microfilarial incidence and count an expectation for future diminution of filariasis was made.

Introduction

Bancroftian filariasis is transmitted from man to man only by vector mosquitoes. Therefore, it is supposed that without vector mosquitoes no transmission will occur and adult filariae in a person will die during some years. Hu (1952) reported "There are a few imported cases of filariasis in Hawaii. They are among new immigrants to the Territory from South Pacific islands. So far, we found 12 out of 186 of these to be carriers of microfilariae (of non-

periodic form of *Wuchereria bancrofti*) in their blood. These positive cases were only found among those who have been in Hawaii for less than six years". This seems to indicate the possibility that complete control of vector mosquitoes for six years will eradicate bancroftian filariasis in a community. However, in the above case the number of persons examined is not enough to draw a conclusion and moreover his statement is concerned with non-periodic form,

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It may be different from our periodic form. As investigations along this line are very useful in understanding the epidemiology of bancroftian filariasis, a filariasis eradication experiment by only the control of vector mosquitoes was planned from 1962 at Nagate Village under the condition of non-treatment of persons with drugs.

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Methods of mosquito control

From 1962 to 1965 a residual spray of insecticide was made onto inside walls and ceilings of all dwelling houses and cowsheds once

a year, and larvicide applications were made to the possible breeding places of *C. p. pallens* once a week, as shown in Table 1.

Table 1. Mosquito control works done at Nagate Village.

Year	Insecticide used for residual spray	Date of application	Quantity (ℓ) per house	Larvicide	Application		Total Quantity (ℓ) used
					Times	Period	
1962	5% DDT E.	Jun. 6-7	7.5	5% Diaz. E. C.	14	Jul.20 - Oct. 18	16.3
1963	0.5% Diazinon E.	Jun. 12-13	7.2	5% Diaz. E.C.	22	Jun.4 - Oct. 28	22.4
1964	0.5% Diazinon E.	Jun. 15-16	8.2	5% Diaz. E.C.	25	May16 - Oct. 29	24.0
1965	0.5% Diazinon E.	Jun. 18-19	6.7	5% Diaz. E.C.	21	Jun.9 - Oct. 27	24.8

Remarks. E.: Emulsion. E.C.: Emulsion concentrate. Residual spraying for dwelling houses and cowsheds was made at a rate of 50cc per m². Larvicide was applied mainly to the breeding places of *C. p. pallens* at a rate of about 1 ppm to the estimated quantity of water when filled up in the cases of cess-pools and fertilizer pits and when supposed to be 5 cm in depth in the case of ditches.

Seasonal prevalence of *C. p. pallens* and infected mosquitoes

Fig. 1 shows seasonal prevalence of *C. p. pallens* in 1962 to 1965 under the controlled condition of mosquitoes as mentioned above, together with the prevalence in 1961 under the uncontrolled condition for comparison. In Fig.1 the prevalence of infected *C. p. pallens* is also shown. Natural infections with each stage filaria larvae in *C. p. pallens* in five years are given in Table 2.

In 1962 anti-larval sprays were not started till one and a half months after the residual spray, and in 1963 some new breeding places were formed unexpectedly owing to the change in the waterway, and consequently some females of *C. p.*

pallens emerged. In 1964 and 1965, *C. p. pallens* was nearly completely controlled. Total infection rates of the vector mosquito are fluctuated by year and appear to be unchanged during five years as seen in Table 2. This is because the collections of mosquitoes were always made in some houses among those with more heavily infected families. However, the number of infected mosquitoes per house decreased clearly and gradually year by year. A mosquito having the second stage larvae was collected in 1962 when control works were done not necessarily successfully. A mosquito with infective larvae was found in

Table 2. Natural infections with each stage larvae of *Wuchereria bancrofti* in *C. p. pallens* collected at dwelling houses having microfilarial carriers in Nagate Village under mosquito controlled conditions from 1962.

Year	Total houses examined	No. of mosquitoes collected	No. of mosquitoes per house	No. (%) of mosquitoes infected	No. (%) of mosquitoes infected		
					with 1st stage larvae	with 2nd stage larvae	with 3rd stage larvae
1961	96	555	5.78	43 (7.7)	38 (6.8)	5 (0.9)	0
1962	201	392	1.95	53 (13.5)	53 (13.5)	1 (0.3)	0
1963	90	241	2.68	20 (8.3)	19 (7.9)	0	1 (0.4)
1964	155	32	0.21	4 (2.5)	4 (2.5)	0	0
1965	49	18	0.37	1 (5.6)	1 (5.6)	0	0

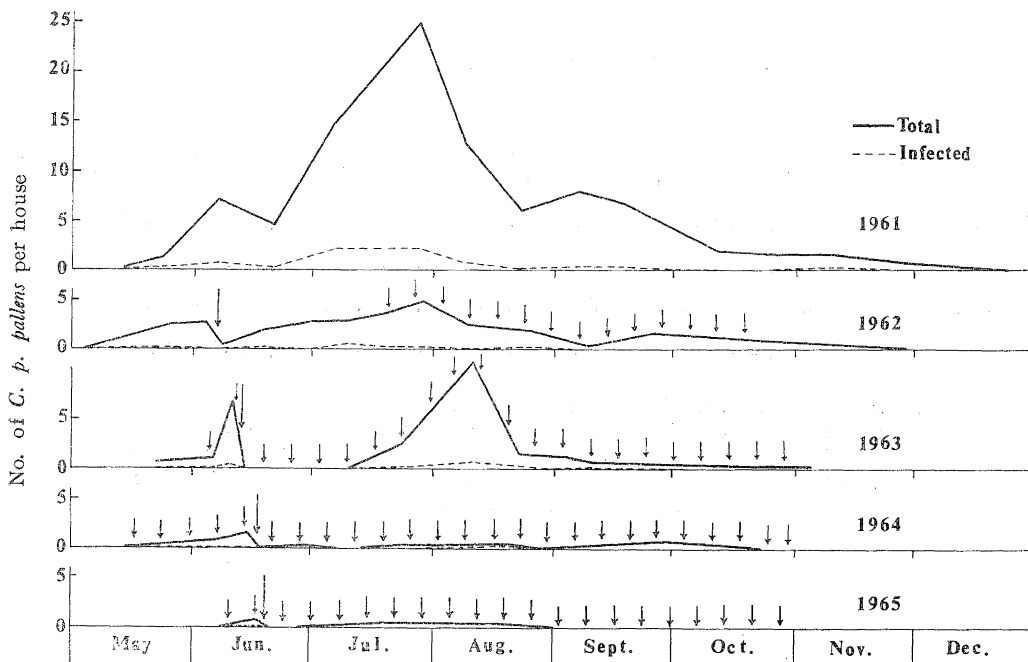


Fig. 1. Seasonal prevalence of *C. p. pallens* collected in houses of microfilarial carriers at Nagate Village in successive five years, under controlled conditions from the second year by residual spray (large arrow) and larvicide (small arrows).

1963 during the temporal and unexpected rise in number of the vector mosquito. On the other hand 1964 and 1965 no such mosquitoes as those having the second or third stage larvae

were captured.

From the above, the chance to the villagers to receive new infection of filariasis within the village seemed to have been extremely small.

Reduction in the microfilarial incidence and density

Table 3 gives the change in the incidence and density of microfilariae in all persons in

Nagate Village during five years under the controlled condition of mosquitoes from the

Table 3. Reduction in the microfilarial incidence and density in Nagate Village.

Year	1961	1962	1963	1964	1965
No. of persons examined	577	571	567	541	493
No. of positives	81	71	62	53	39
% positive	14.0	12.4	10.9	9.8	7.9
Total No. of microfilariae *	6408	4794	3851	1761	1057
No. of microfilariae per positive *	79.1	67.5	62.1	33.1	27.1

* No. of microfilariae in 60mm³ blood.

second year. Microfilarial incidence decreased gradually from 14.0% in 1961 to 7.9% in 1965. Mean number of microfilariae per positive person also decreased from 79.1 in 60 mm³ blood in 1961 to 27.1 in 1965.

The above data are based on the examinations conducted for all persons in the village. But, some persons including microfilarial carriers moved out from or into the village during the experimental period. Therefore, with only residents, the results of examinations in five successive years are given in Table 4, which shows similar trend of reduction in the incidence

Table 4. Reduction in the incidence and density of microfilariae of 413 persons who had settled down for five successive years in Nagate Village.

Year	1961	1962	1963	1964	1965
No. of positives	63	53	51	46	36
% positive	15.3	12.8	12.3	11.1	8.7
Total No. of microfilariae *	3948	2714	2285	1413	815
No. of microfilariae per positive *	62.7	51.2	44.8	30.7	22.6

* No. of microfilariae in 60mm³ blood.

and density to that for all persons shown in Table 3.

During the experimental period of five years, some persons were continuously positive, some turned to negative in the second year, some in the third year, and so on. Thus, 413 persons, who did not move, were classified into 18 groups by the infection state of filariasis, and the number of persons in each group and the mean number of microfilariae in 60 mm³ blood of them are given by year in Table 5. Groups 1 to 4 include 31 persons who have been clearly or probably positive for the whole experimental period of five years. Groups 5 to 9 include 31 persons who turned to negative at a certain time of the period. Six persons belonging to Groups 10 to 13 were those who may be newly infected during the period. Among them, a person of Group 10 was negative in 1961 and became positive in 1962

Table 5. Mean number of microfilariae in 60mm³ blood of the persons belonging to the different groups of infection state of filariasis.

Group	1961	1962	1963	1964	1965	No. of persons
1	81.3	75.9	70.1	43.2	28.0	27
2	22.5	38.0	26.5	0	2.0	2
3	1.0	2.0	0	3.0	4.0	1
4	16.0	0	11.0	10.0	16.0	1
5	117.0	45.8	23.7	16.2	0	9
6	80.8	16.0	9.2	0	0	5
7	24.7	5.3	0	0	0	6
8	7.8	0	0	0	0	10
9	1.0	2.0	0	1.0	0	1
10	0	58.0	26.0	9.0	0	1
11	0	0	11.7	22.7	9.0	3
12	0	0	0	3.0	8.0	1
13	0	0	0	0	1.0	1
14	0	2.0	0	0	0	1
15	0	0	1.5	0	0	2
16	0	0	0	3.0	0	2
17	6.0	0	5.0	0	0	1
18	0	0	0	0	0	339
Total						413

by the probable infection in 1961 when the mosquito control had not been started. Of the remaining five persons, three persons have frequently stayed at neighbouring villages with microfilarial incidences of 0.8% to 11.8%, under the strong possibility of filarial infection outside the Nagate Village. With the last two persons it is uncertain whether or not they were infected

within the village. Groups 14 to 17 include 6 persons who were found positive only once or twice during five years and found to have very small number of microfilariae. This seems to be due to their infection being old or very light and expected to become negative in due course of time. 339 persons belonging to Group 18 were consistently negative for microfilariae.

Expectation on the future reduction in the incidence

It is rather difficult to predict the future change of microfilarial incidence and density at Nagate Village under continuation of mosquito control works. However, as this problem is very interesting, the prediction was tried as shown in Fig. 2. The mean No. of microfilariae in 60 mm³ blood per positive person constantly decreased from 1961 to 1965, as shown in the bottom figure of Fig. 2, and if it is supposed that this trend of the change continues, no microfilariae will be found in the 413 persons in 1968. The percentage of microfilarial positives (top figure) also constantly decreased from 1961 to 1965, though the percentage for 1962 is somewhat lower. The decrease in the percentage will be accelerated after 1965, because persons with a very small number of microfilariae will become larger in number as years roll on and therefore these persons will more easily turn to negative

than in the preceding years. Thus, it may be expected that filariasis will almost completely disappear in Nagate Village by 1968.

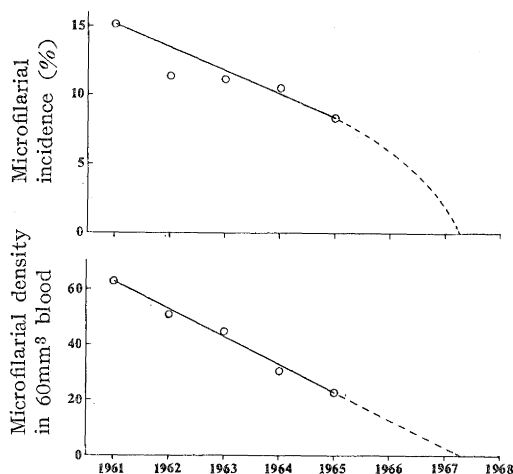


Fig 2. Trend of change of microfilarial incidence and density (shown in Table 4) and the expectation on the future reduction in the incidence and density (shown by broken lines).

Summary

In a village with bancroftian microfilarial incidence of 14.0% in 1961, control works for an important vector mosquito, *Culex pipiens pallens* have been operated since 1962. Residual spraying was made once a year usually on early or mid June and weekly larvicide applications were made every year covering the breeding season of the vector mosquito. By these the mosquito

population has been suppressed to the level on which no apparent filaria infection could be observed within the village. Considering the reduction in microfilarial incidence and density during the five years from 1961 to 1965, filariasis in the village may be expected to disappear nearly completely by 1968, on condition that the vector control works will be continued.

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長崎県長手，鏡瀬両部落におけるバンクロフト糸状虫症の疫学的研究，特に伝搬蚊との関係について。
4. 伝搬蚊の駆除によるフィラリアの撲滅実験。和田義人，長崎大学医学部医動物学教室（主任：大森南三郎教授），長崎大学風土病研究所衛生動物部（主任：大森南三郎教授）。

総 括

長崎県長手部落（1961年の仔虫保有率：14.0%）において，1962年から1965年にかけて年1回の残留噴霧と週1回の幼虫駆除によって伝搬蚊を駆除し，部落内で殆んどフィラリアの感染が起らない程度にまで蚊の個体群密度を下げる事ができた。1961年から1965年間の部落民の仔虫保有率と平均仔虫数の減少状態から推して，もし今後も伝搬蚊の駆除を続けるならば，本部落のフィラリアは1968年頃迄には殆んどなくなってしまうであろうと予測された。

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