

STUDIES ON THE TRANSMISSION POTENTIAL OF SURVIVING MICROFILAREMIAS AFTER BASIC CONTROL OF FILARIASIS

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Abstract. After filariasis was basically controlled (the microfilarial rate was lower than 1%) in Henan Province in 1987, longitudinal observation of the disease has been carried out in all the province in order to study the regular pattern of growth and decline or the transmission potential of the disease. According to the distribution of filaria species and original microfilarial rate, 7 administrative villages in 7 counties were selected as surveillance sites. From 1988 to 1995, etiological and mosquito vector surveys were made continuously in all sites where no control measure was conducted. 10 surviving microfilaremic individuals became negative gradually over the first 6 years and no new microfilaremia was found. Since then, the microfilarial rate was zero. During the 8 years, 19 vector mosquitos were positive, with a total of 33 filarial larva. *Culex pipiens pallens* was the predominant mosquito species inside human dwelling in all sites. The man-biting rate of mosquitos for outdoor sleepers fluctuated greatly, the highest was 360.60 mosquitos per man per night and the lowest 7.20. The man-biting rate of mosquitos for sleepers inside mosquito-nets was ~ 1. The proportion of multiparous mosquitos also fluctuated greatly, the highest was 88.10% and the lowest 27.27%. According to the data described above, the man-biting rate of mosquitos which contained filaria L3 was less than 1 mosquito per man per transmission season. It is suggested that after the microfilarial rate was lower than 1%, the surviving microfilaremias became negative gradually in 3-5 years, and the transmission of the disease was blocked. Therefore, in the districts where filariasis was basically controlled, elimination of the disease was attainable.

INTRODUCTION

Henan Province earlier was a low and middle endemic area of filariasis which covered 71 counties, the microfilaremias and advanced patients with signs were over 2.5 million. Through work done by all the workers responsible for filariasis control of the province (mainly taking the measures of treatment and examination of patients, and mass treatment with DEC-salt), the filarial rate was induced below 1%, taking the administration village as the counting unit (the criteria of basic elimination of Chinese Ministry of Health). In order to observe the distant effects of control, the effects of surviving microfilaremias on the transmission of filariasis and exploring the ability of blocking transmission under the condition of not taking any specific measures, 7 surveillance sites in 7 counties were set up

according to geographic distribution, species of filaria, former microfilarial rate and the number of surviving microfilaremias. Since 1988, longitudinal epidemiologic surveillance on the etiology and mosquito vectors has been carried out.

MATERIALS AND METHODS

Selecting sites

Seven surveillance sites in 7 counties, respectively were selected whose conditions in 1988 are listed in Table 1.

Surveillance of etiology

Blood examination was carried out once in every 2-3 years for all the population over 1 year old in all sites, in the intervening years only for the former and for surviving microfilaremias. The examination rate must be above 90% of the population. Six

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Table 1
Background of the surveillance sites.

Surveillance sites	Total of population	Pre-control MF rate (%)	Control measures	When the sites were set		Species of filaria
				No. mf positive	Mf rate (%)	
Shangcheng	1,346	10.40	*	0	0.00	<i>W. bancrofti</i> and <i>B. malayi</i>
Gushi	2,166	15.85	*	0	0.00	<i>W. bancrofti</i> and <i>B. malayi</i>
Xinye	2,826	0.40	*	3	0.11	<i>W. bancrofti</i> and <i>B. malayi</i>
Runan	2,022	8.22	*	2	0.10	<i>W. bancrofti</i>
Queshan	8,752	15.30	*	2	0.03	<i>W. bancrofti</i>
Xiangchen	1,720	11.30	*	2	0.11	<i>W. bancrofti</i>
Xiayi	1,372	23.14	*	1	0.08	<i>W. bancrofti</i>

* Case treatment and mass drug administration with DEC medicated salt

drops of blood (about 120 µl blood) was taken from the two ears of one person at the time after 21.00 hours and was spread to two thick films, then routine microscopy was performed, counting the number of larvae.

Serologic surveillance

About 300 persons were selected by mass sample method in every site. Three drops of blood was taken from the ear of each person, then directly dropped on filter paper, shaped as a round blood disk whose diameter was about 1.2 cm. It was preserved under dry conditions at a temperature below -30°C. The IFAT method was used to detect the serum antibody against filaria.

Surveillance of mosquito vectors

Investigation of the natural infection rate of filarial larvae in the mosquito: 3,000-5,000 female mosquito vectors were captured inside houses in surveillance villages. These mosquitoes were narcotized in the laboratory the same day, identified for species, counted, then dissected individually, and larvae of filaria detected by microscopy.

Observation on the man-biting rate of mosquito: An open representative spot in the surveillance village was selected where the mosquito vector was captured by means of the human-bait method from

19:00 to 06:00 hours. These mosquitoes were identified for species and were counted. The number of mosquitoes captured in an open single-man-net represents the man-biting rate for outdoor sleepers. This observation on the biting rate was repeated 5 times every transmission season. In the above villages 50 mosquito-nets in 50 households were selected inside which all the mosquitoes were captured 05.30-08.00 hours. All the new blood-fed mosquitoes and persons inside the net were counted. Dependent upon the data, the biting rate for sleepers inside mosquito-net was calculated.

Observation on the ratio of multiparous mosquitoes: The mosquitoes captured in the all-night-observation were dissected individually. According to the change of the ovariole and the shape of tracheal branch on the ovary surface, the multiparous and non-multiparous mosquitoes were identified, to obtain the ratio. This was done from July to September in every year.

RESULTS

Surveillance of parasites

Through mass blood examination, 10 microfilaremias was found in the 7 surveillance sites during 1988-1989; 4, 4, 1, 1 microfilaremias became negative in 1990, 1991, 1992, 1993, respectively. The average filarial rate dropped annually

(from 0.06% in 1988 to 0 in 1993). The average density of microfilaria in blood of microfilaremia cases was low (the highest density was 3.25 larvae/60 μ l blood). The 10 who became negative did not return to positive in 1993 to 1995 through blood examination (Table 2). No new microfilaremias were found for 8 consecutive years.

Serologic surveillance

Serologic investigation through mass sampling was done by IFAT method in 1990. One thousand and nineteen persons in 3 sites were selected and their blood films made on filter paper; 53 of these samples were positive and the positive rate was 5.2%. In 1991, 655 samples were selected in 2 sites and examined; the positive rate was 0.46%.

Surveillance of mosquito vector

Investigation of the mosquito vector was made in 6, 6, 6, 4, 3, 6, 6 sites in 1988 (1989), 1990, 1991, 1992, 1993, 1994, 1995, respectively. The vector mosquitos captured in these years were 91,528, 51,814, 30,342, 1,110, 13,834, 24,661 and 23,295, and the positive mosquitos were 9, 4, 3, 0, 2, 1 and 0 (Table 3), the number of larvae detected in mosquitos were 9, 16, 0, 5, 2, 1 and 0 (Table 4). The highest infection density in mosquitos was 10 larvae/mosquito which were identified as third-stage

larvae of cattle filaria. In the other positive mosquitos, the infection density was 1-2 larvae/mosquito which were identified as first-stage or second-stage larvae, whose species could not be determined. Aside from the finding that the constitution of mosquito species in human houses changed a little in these sites, the dominant species of mosquito was *Culex pipiens pallens*.

The man-biting rate of mosquitos on outdoor sleepers varied greatly, the highest was 360.60 mosquito/person night, and the lowest 7.20. The biting rate for sleepers inside mosquito-nets varied less. In general it was 1 mosquito/person night (Table 5, 6). The ratio of multiparous mosquitos varied greatly, the highest was 88.10%, and the lowest 27.27% (Table 7).

DISCUSSION

After filariasis was basically controlled in Henan Province, longitudinal surveillance on etiology and mosquito vectors have been carried out for 8 years. Although no measure of pathogen control was taken, the microfilarial rate declined annually and the microfilarial density remained at a low level. In the sixth year (1993) after filariasis was basically controlled, the 10 surviving microfilaremias were all became negative. No new microfilaremias were found and the microfilarial rate had declined to 0.

Table 2
Results of blood examination for microfilaria in population of the 7 sites.

Surveillance sites	No. mf positive						
	1988(89)	1990	1991	1992	1993	1994	1995(year)
Shangcheng	0	0	0	0	0	0	0
Gushi	0	0	0	0	0	0	0
Xinye	3	2	0	0	0	0	0
Runan	2	1	1	0	0	0	0
Queshan	2	2	0	1	0	0	0
Xiangchen	2	0	0	0	0	0	0
Xiayi	1	1	1	0	0	0	0
Total	10	6	2	1	0	0	0
Mean mf density (No. mf/60 μ l)	1.30	1.37	3.25	1.50	0	0	0
Mean mf rate (%)	0.06	0.03	0.01	0.01	0	0	0

Table 3
Natural infection rate of filarial larvae in mosquitos.

Surveillance sites	Natural infection rate % (No. mosq positive/No. mosq dissected)						
	1988(89)	1990	1991	1992	1993	1994	1995
Shangcheng	0.00 (0/16,057)	0.00 (0/4,068)	0.00 (0/4,494)	0.00 (0/3,857)	-	0.00 (0/4,376)	0.00 (0/4,846)
Gushi	0.00 (0/7,771)	0.00 (0/7,214)	0.00 (0/4,670)	0.00 (0/4,573)	-	0.00 (0/3,088)	0.00 (0/3,687)
Xinye	0.01 (1/13,885)	0.00 (0/14,136)	0.00 (0/5,897)	-	0.02 (1/5,238)	0.02 (1/5,268)	0.00 (0/4,385)
Runan	0.02 (4/18,439)	0.01 (1/9,408)	0.06 (3/4,830)	0.00 (0/5,238)	-	0.00 (0/3,676)	0.00 (0/3,610)
Xiangchen	0.02 (4/16,530)	0.01 (1/7,875)	0.00 (0/4,904)	0.00 (0/2,442)	0.00 (0/3,834)	0.00 (0/3,803)	0.00 (0/3,844)
Xiayi	0.00 (0/18,846)	0.02 (2/9,118)	0.00 (0/5,517)	-	0.02 (1/4,762)	0.00 (0/4,450)	0.00 (0/2,923)
Total	0.01 (9/91,528)	0.01 (4/51,814)	0.01 (3/30,342)	0.00 (0/16,110)	0.01 (2/13,834)	0.00 (1/24,661)	0.00 (0/23,295)

Table 4
Results of examination of filaria larvae in mosquito vectors.

Surveillance sites	No. filaria larva (No. L3)						
	1988(89)	1990	1991	1992	1993	1994	1995
Shangcheng	0 (0)	0 (0)	0 (0)	0 (0)	-	0 (0)	0 (0)
Gushi	0 (0)	0 (0)	0 (0)	0 (0)	-	0 (0)	0 (0)
Xinye	1 (0)	0 (0)	0 (0)	-	1 (0)	1 (0)	0 (0)
Runan	4 (0)	10 (10)	5 (5)	0 (0)	-	0 (0)	0 (0)
Xiangchen	4 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Xiayi	0 (0)	5 (0)	0 (0)	-	1 (0)	0 (0)	0 (0)
Total	9 (0)	16 (10)	5 (5)	0 (0)	2 (0)	1 (0)	0 (0)

The natural infection rate of filarial larvae in mosquito vectors was also kept at low level (0.01%-0). In these 8 years 19 positive mosquitos were found, in whose bodies 33 filaria larvae were detected. 10 third-term larvae of the 33 were identified as cattle filaria. Also, according to our former findings, there were animal filaria in Henan (Chang *et al*, 1997). Therefore, it was possible that some of the other first and second- stage filaria larvae were animal species. Although the presence of filarial

larvae in mosquitos means potential for transmission of the disease, in the final host there must be female and male larvae for mating and multiplication probabilities that are low. The continuous 8 years observation showed that no new microfilaremias was found, so that the data described above indicate that the filariasis transmission was blocked under present conditions in Henan Province. Similar results have been reported in other endemic areas in China (Wu *et al*, 1993). So, under

Table 5

Survey on the man-biting rate of mosquito vectors for outdoor sleepers.

Surveillance sites	The biting rate (No. mosquito/man night)						
	1988(89)	1990	1991	1992	1993	1994	1995
Shangcheng	66.10	22.78	194.78	95.11	-	360.60	52.63
Gushi	52.75	75.44	117.86	51.88	-	29.60	71.60
Xinye	58.78	24.11	113.81	-	46.40	47.40	40.40
Runan	49.35	41.57	39.00	33.80	-	11.60	22.00
Xiangchen	36.60	53.33	29.00	15.40	10.00	9.80	7.21
Xiayi	26.00	21.80	49.60	-	18.80	30.67	25.40

Table 6

Survey on the man-biting rate of mosquito vectors for sleepers inside mosquito-nets.

Surveillance sites	The biting rate (No. mosquito/man night)						
	1988(89)	1990	1991	1992	1993	1994	1995
Shangcheng	1.08	0.49	0.32	0.48	-	60.34	1.25
Gushi	0.83	1.04	1.34	0.24	-	1.25	1.36
Xinye	2.15	0.94	5.21	-	1.45	1.18	1.15
Runan	1.47	0.57	1.05	0.42	-	0.28	0.79
Xiangchen	1.30	1.69	1.15	1.14	1.13	1.08	1.26
Xiayi	1.75	1.06	2.79	-	1.05	1.01	1.56

Table 7

Survey on ratio of multiparous mosquitos.

Surveillance sites	The ratio of multiparous mosquito (%)						
	1988(89)	1990	1991	1992	1993	1994	1995
Shangcheng	42.45	62.62	66.69	58.19	-	84.64	38.48
Gushi	75.28	81.30	88.10	80.44	-	76.92	56.00
Xinye	50.72	58.99	43.59	-	45.69	46.84	46.03
Runan	75.51	75.94	75.89	75.14	-	82.76	71.81
Xiangchen	78.68	74.20	64.80	27.27	37.77	32.32	30.55
Xiayi	74.45	72.19	66.24	-	82.98	73.73	50.86

the condition of the microfilarial rate below 0.5%, the density of microfilarial being below 5 larvae/60 μ l blood, the filariasis transmission considered to be zero.

That the 10 surviving microfilaremias became negative in 6 years, is possibly related to the life-

span of adult worms. These results was similar to the reports in other endemic areas (Shi *et al*, 1988; Shen *et al*, 1987; Pan *et al*, 1990; 1993) *ie* under the condition of the microfilarial rate being below 1%, the surviving microfilaremias can become negative in 3-5 years. Also according to the crosswise sur-

veillance, the average microfilarial rate in endemic areas of Henan Province was 0.04% in 1987, which was below the 0.06% of the 7 sites' microfilarial rate. Therefore, by inference, after the filariasis was basically controlled, although no control measure for pathogen was taken, the surviving microfilaria outside the sites in Henan endemic areas become negative in several years and the filariasis could be eliminated by itself.

The transmission of filariasis was also affected by the constitution of the mosquito population, habits, biting rate, ratio of multiparous mosquito. According to recent investigations, the data described above were a little different in various years, but this was not large. It was calculated that the man-biting rate of mosquito which contained filaria L3 was less than 1 mosquito per man per transmission season for outdoor sleepers: for sleepers inside mosquito-nets it was much lower. Along with the improvement of socio-economic conditions strengthening the idea of self-protection and use of facilities to prevent mosquito biting, the chance of contact between mosquito and human is being reduced gradually and will be beneficial for the elimination of filariasis.

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