**Wuchereria bancrofti** infection in human and mosquito populations of a Polynesian village ten years after interruption of mass chemoprophylaxis with diethylcarbamazine


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**Abstract**

In 1991, a study on *Wuchereria bancrofti* microfilariae (mf) and infection rates was carried out in the human and mosquito populations of a Polynesian village where, 10 years before, the mf prevalence rate was 6.4%- and twice-yearly mass treatment with 3 mg/kg of diethylcarbamazine (DEC) was interrupted. Venous blood samples were collected from 575 (97%) individuals aged 15 years or more, of whom 122 (21.4%) were mf positive. The mf carrier prevalence rate was 27.4% in males, significantly higher than that of 14% in females; it increased from 7-12% in the youngest age group (15-19 years) to 40-50% in the oldest (≥60 years) for both males and females. 387 mosquito collections were performed and 1748 female *Aedes polynesiensis* were dissected, of which 1176 were parous. Among the latter, 114 (9.7%) were infected with *Wuchereria bancrofti* larvae at L1, L2 or L3 stages. The mean number of larvae per mosquito was 2.46 (range 1-15). Of the 114 infected mosquitoes, 30 harboured L3 larvae, giving a 2.55% infective rate; the mean number of L3 larvae per mosquito was 1.15 (range 1-2). Such findings indicate that the interruption of systematic twice-yearly mass treatment with DEC (3 mg/kg) has resulted, after 10 years, in a substantial increase of microfilarial prevalence in humans, and in high infection rates in mosquitoes.

**Introduction**

In French Polynesia, lymphatic filariasis due to subperiodic *Wuchereria bancrofti* var. *paciifica* is transmitted by the vector mosquito *Aedes polynesiensis*. Between 1950 and 1966, filariasis control programmes were implemented, based on the distribution of diethylcarbamazine (DEC) using various dosages and schedules, mainly 3 and 6 mg/kg doses of DEC given either daily for 6 d every 6 months or monthly for 12 months to the whole population in the village. In some islands, selective treatment using 2.5-6 mg/kg of DEC were given to microfilariae (mf) carriers only (Saugrain & Outin-Fabre, 1972; Merlin et al., 1976). Since the mid 1970s the filariasis control strategy has become the twice-yearly administration of single doses of 3 mg/kg of DEC to the whole Polynesian population. As a result of these different strategies, the mf carrier prevalence rate, which was estimated to be around 30% by the beginning of the 1950s, fell to 0.3-2% in the population of Tahiti, the main island (Southgate, 1974) and because of the reluctance of parents to have venous blood samples collected from children.

**Material and Methods**

The coastal village of Opoa extends over some 12 km between mountain and sea and is located about 30 km from the main town on Raiatea island. According to the 1988 census, its population was 976. The last mf carrier prevalence rate was determined in 1980, indicated that, of 414 adults sampled (by 20 mm³ finger-prick blood samples), 28 (6.4%) were mf positive (mf were seen in stained blood films). That evaluation was routinely performed on as many inhabitants as possible, without using randomization.

In January–February 1991 a team of one physician and one health worker visited each house of the village to update the census, to establish a map indicating the location of each house, and to collect venous blood samples from all inhabitants aged 15 years or more. Samples were sent every day to the Institut Malardé in Tahiti where 1 ml of blood was filtered through a Nucleopore membrane which was then stained by the Giemsa method for counting microfilariae. The filtration technique was chosen, because it is by far the most sensitive for deter-
Table. Distribution of Wuchereria bancrofti carriers and microfilariae counts according to sex and age, amongst the inhabitants of Opoa village, French Polynesia, 1991

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Carriers No.</th>
<th>Carriers %</th>
<th>Total No.</th>
<th>Microfilariae* Mean^</th>
<th>Range No.</th>
<th>Mean^</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>12</td>
<td>9.4</td>
<td>125</td>
<td>1-4131</td>
<td>8</td>
<td>11.8</td>
<td>8</td>
</tr>
<tr>
<td>20-29</td>
<td>17</td>
<td>11.1</td>
<td>98</td>
<td>1-7055</td>
<td>17</td>
<td>18.9</td>
<td>17</td>
</tr>
<tr>
<td>30-39</td>
<td>21</td>
<td>21.6</td>
<td>129</td>
<td>295-5954</td>
<td>17</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>40-49</td>
<td>14</td>
<td>19.3</td>
<td>126</td>
<td>1-8160</td>
<td>11</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>50-59</td>
<td>26</td>
<td>37.7</td>
<td>861</td>
<td>3-7769</td>
<td>19</td>
<td>55.9</td>
<td>19</td>
</tr>
<tr>
<td>60+</td>
<td>23</td>
<td>45.2</td>
<td>372</td>
<td>2-7616</td>
<td>14</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>122</td>
<td>21.4</td>
<td>352</td>
<td>1-8160</td>
<td>86</td>
<td>27.4</td>
<td>86</td>
</tr>
</tbody>
</table>

*Microfilariae:

Number of larvae per mosquito was 2.46 (range 1-15).

Discussion

With respect to W. bancrofti infection in the human population, the first finding to emerge from our data is the high (21.4%) mf prevalence rate compared to that of 6-4% in 1980 (evaluated by mf counts in 20 mm fringe finger blood samples) at the time when systematic distribution of DEC to the population was stopped. From early and recent studies (Yorke & Blacklock, 1917; Eberhard et al., 1988) it is assumed that distribution of microfilariae between venous and capillary blood systems is very uneven and that conversion from capillary to venous mf counts might be misleading. In fact, while examination of larger volumes of venous blood permits the detection of higher number of infected persons (Descottitz et al., 1973; Southgate, 1974), mf concentrations are very likely to be higher in finger-prick than in venous blood (Eberhard et al., 1988). However, from the results of the present study, it may be assumed that the interruption of the twice-yearly mass chemotherapy has resulted in a substantial increase of mf prevalence in the adult population of Opoa village.

Higher mf prevalence rates in males than in females have already been reported (Southgate, 1974; Samarawickrema et al., 1987b), the explanation being that males are more often exposed to mosquito biting during their daily activity, mainly in plantations. Moreover, at the beginning of 1990, about 100 persons, mainly pregnant women and their young children, were given a dose of 3 mg/kg of DEC. This may account for the absence or scarcity of microfilariaemia in females between 20 and 39 years of age. The fact that the mf prevalence rate increased steadily with age to reach a maximum in both males and females in the 50 years of age or over remains difficult to explain. Such a constant increase is not consistent with the findings of Southgate (1974) in Fijian W. bancrofti carriers. From the results of that study, using the membrane filtration technique, the maximum mf prevalence rate was in the 10-12 years age group; in older age groups only mf densities fluctuated. Also, in a recent study in Ixdia by Pani et al. (1991), a maximum mf prevalence rate of 10-12% was observed in both male and female W. bancrofti carriers in the 10-19 years age groups, and it remained roughly stable in the older age groups. In another recent study in China (Li et al., 1991) the mf prevalence rate rose with age in W. bancrofti carriers but not in Brugia malayi carriers; microfilariaemia was not determined by the membrane filtration technique. Finally, in one study only the mf carrier rate peaked in the oldest age group (>41 years) of a Papan population to a level as high as 50%, but it was already 62% in the <10 years age group (Kazura et al., 1984).

Concerning W. bancrofti infection in mosquitoes, the 9.7% rate we found in Ae. polynesiensis is not very different from those found in Culex quinquefasciatus, either in north Trinidad (Nathan et al., 1987) or in China (Fan, 1990), which were respectively 6.4 and 10.3%, but much higher than that of 0.84% found in Ae. polynesiensis in Samoan villages (Samarawickrema et al., 1987a). Also, the 2.5% mean worm load per mosquito found in the current study was roughly similar to those observed in Cx quinquefasciatus in China and in Trinidad (6-4 and 5 respectively), while the 2.55% rate of infective L3 larvae in Ae. polynesiensis was very different from that of 6-4% observed in Cx quinquefasciatus in China, but much higher than those observed in Cx quinquefasciatus in Trinidad (0-1%) or in Samoan Ae. polynesiensis (0-27%).

In conclusion, our findings indicate that, after 10 years, the interruption of mass treatment with DEC spaced doses has resulted in a substantial increase of the mf prevalence rate in humans, which has reached a level higher than 20%, and in high infection and infective rates in mosquitoes. They also show that the transmission of lymphatic filariasis is very active in the village and that adequate mass treatment should be promptly resumed, the efficacy of which should be evaluated in humans and mosquitoes.

Acknowledgements

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