

A STUDY OF FILARIASIS IN PORTO RICO

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Porto Rico is one of the best known endemic areas of filariasis in the Western Hemisphere. The history of this disease in this Island appears to date back to the days of the slave trade. The cities along its coastal plains took early advantage of the importation of negro labor from Africa, and with a favorable climate and a suitable intermediate host for the transmission of *Wuchereria bancrofti* endemic centers of filariasis were soon established. In the course of time, the most striking clinical manifestation of the infestation, elephantiasis, came to the notice of the Spanish physicians. The records of the Spanish hospitals would probably throw some light on the early history of elephantiasis and allied diseases in Porto Rico. These, however, were not available for the present study.

The first study of importance on this subject is the report of an investigation of fifty cases of filariasis studied by Martínez Álvarez⁽¹⁾, in the district of Puerta de Tierra in the city of San Juan. He recognized this district as an endemic center and observed that the disease was met with in certain well defined areas in this locality and was not spread throughout the district. Hoffman, Burke and Marín⁽²⁾ made an extensive survey of filariasis in the Island and O'Connor and Burke⁽³⁾ studied the clinical aspects of filarial infection in some of the endemic areas. These three studies form the background of this short investigation of the problem.

Hoffman and his associates have shown that some parts of Santurce, which is very close to San Juan, are heavily infected. A small area of Santurce was, therefore, selected for this study. A house-to-house survey of this area was not felt to be feasible not only on account of the limited time available, but also because of the difficulty experienced in persuading the average householder to submit himself and family to the inconvenience of a blood examination at night. The study, therefore, was confined to two large pub-

lie institutions situated within this area, the Boys' Charity School and the Blind School, and to an unselected sample from the general population obtained from volunteers among those attending the out-patient municipal dispensary at Santurce. Another group included in this study was obtained by taking all the in-patients in the General Wards of the Presbyterian Hospital and the University Hospital of the School of Tropical Medicine.

A clinical as well as a blood examination was made in every case. Elephantiasis, lymphangitis, orchitis, hydrocele and enlargement of the inguinal glands were taken as evidences of filariasis. Only those persons exhibiting any of these signs, in the absence of other conditions which may reasonably account for them, were considered as clinically positive. Blood smears were taken between 8 and 10 P. M. and examined systematically the following day after staining with haematoxylin. Examination was usually made under the low power of the microscope, but the diagnosis of positive for the microfilariae of *Wuchereria bancrofti* was confirmed in every case with the oil immersion lens. The results of this clinical and blood examination are given in Table I.

It is seen from Table I that the highest microfilarial rate is in the Boys' Charity School and the highest clinical rate among those examined at the Santurce dispensary and University Hospital. Taking the total positives, the group examined at the dispensary and the University Hospital, representing an unselected sample of the general population in this area, shows the highest incidence. This combined index appears to give a more reliable estimate of filarial infection in a place on account of the tendency shown by the microfilariae to disappear from the blood stream when clinical filariasis, especially elephantiasis, develops.

A study of the age distribution of this group showed that microfilarial rates are high in the earlier age groups and clinical filariasis rates are high in the later age groups. There was no case of elephantiasis below the age of twenty. These results are in agreement with the findings of Anderson, Khalil, Lee and Leiper⁽²⁾ in British Guiana, although in Fiji, Bahr⁽³⁾ found microfilarial rates definitely increasing with increasing age. In certain other regions,⁽⁴⁾ however, it has been found that microfilarial rates showed no correlation with age. In all these places, clinical filariasis was found to be distinctly on the increase in later age groups.

In the Boys' Charity School where the greater part of this study was carried out, definite correlation between the infection rates

among boys and their length of residence in the school was noticed by Hoffman and his associates in 1928. This observation is confirmed in the present study as is shown in Table 2. This table shows that the Boys' Charity School continues to be an active endemic focus of filariasis.

The clinical types met with in this study were mostly filarial fever, lymphangitis and elephantiasis. There were also a few cases of hydrocele, orchitis and enlarged inguinal glands, but there were no cases of chyluria. The general infection rate in the group studied as well as the maximum rates as obtained from the Boys' Charity School may be considered low when compared with the rates prevailing in the well known endemic centers of filariasis in Africa, South America, India or the Pacific Islands.

In the study of the intermediate host of *Wuchereria bancrofti* in Santurce, the object aimed at was to find out the types of mosquitoes common in the locality and ascertain the extent of infection among them. The study was, therefore, confined to an examination of "wild" mosquitoes collected from the area already surveyed for the clinical and blood infection rates. By dissecting these mosquitoes, it was attempted to obtain an index of the infectivity of the mosquitoes in this locality. The largest collection of mosquitoes came from the Boys' Charity School from which also came most of the cases in the clinical and parasitic study. As the work was done towards the close of the academic year when a large number of the boys were expected to leave for their homes for the summer holidays, the mosquito collection in the institution was made in successive batches in two different periods, the one when the school was in full swing and the other a week or ten days after the closing of the school, when only ten out of the thirty-five boys with microfilaria in their blood were left in the institution. Mosquitoes were also collected from the School for the Blind and from a few houses around. On the whole, the mosquito sample may be considered fairly representative of the groups studied and is roughly equal in numbers also, in each area, to the number of persons included in the clinical and parasitic study. Only female mosquitoes with evident signs of a full meal were included in the catches.

These mosquitoes were kept in cages in the laboratory and were examined and dissected as they died. In the whole group of 572 mosquitoes studied, only 31 showed developmental stages of *Wuchereria bancrofti* in their bodies. The infected mosquitoes had a definitely shorter span of life than the uninfected. The identification

showed that out of these 52 mosquitoes, 543 were *Culex quinquefasciatus* (*fatigans*) and 29 were *Aedes aegypti*. The infected mosquitoes belong only to the first species. Table 3 shows the number and percentage of infected mosquitoes in the various groups investigated. The Boys' Charity School, with the highest microfilarial rates, also showed the highest mosquito infection rates. The rates showed wide variation in the two groups of collections from the school. The rate of mosquito infection was 7.1 per cent when the school was full and only 2.4 per cent when the school was closed with only a few boys left. The average rate of infection for mosquitoes in this study was only 5.4 per cent with a maximum rate of 7.4 per cent in the Boys' Charity School (when the school was full). This shows a comparatively low infection rate when compared with those prevailing in well known endemic centers of filariasis elsewhere.

There are plenty of breeding places for *Culex* mosquitoes in the area where this study was carried out. An open ditch carrying sewage and ground water crosses this area and part of its channel and adjoining swamp grounds offer excellent breeding places for these mosquitoes. Extensive breeding places of this type are to be found in the premises of the School for the Blind and about two blocks away from the Boys' School, and smaller ones are seen in many of the houses around.

To the government and to the people in general, the chief interest in a study like the one outlined is whether the disease constitutes a major public health problem. In considering this question, it has to be remembered that in a tropical country like Porto Rico, every infection easily assumes major importance on account of the general conditions. Judged by its position in the mortality returns and the areas involved, filariasis is no doubt a very minor problem as only some of the badly congested urban areas are seriously affected. It cannot, therefore, be placed on the forefront of a public-health program for Porto Rico like tuberculosis, malaria or hook-worm disease. But within the comparatively narrow limits where it is endemic, it is responsible for considerable suffering, causing repeated incapacitation of the workers, a general lowering of their vitality and serious economic loss to the individual and the community. Within these limits, therefore, it constitutes a serious public-health problem, requiring the efforts of the government for the relief of suffering and for the control of the infection.

It is not proposed to discuss at any length in this paper the

control measures needed against filariasis in Porto Rico. In the absence of a suitable drug for treatment, the attacks against the disease will have to be confined to the control of the insect host and personal prophylaxis to prevent infection. Control of the insect host, similar to the "species control" now common in anti-malarial campaigns, is quite possible in filariasis and appears on theoretical grounds to be easier in application than in the case of malaria.

Having these considerations in view, the organization of a campaign for the control of filariasis in Porto Rico will involve, first a complete survey of the island to locate endemic centers requiring active control and for finding out the types of mosquitoes that are to be dealt with. The present study has incriminated only *Culex quinquefasciatus* (*fatigans*) but more observations are needed to determine all the species to be dealt with. The next step will be the formation of an anti-mosquito squad for detection of breeding places and their elimination by filling, drainage and other suitable anti-larval measures. In view of the protection afforded by personal hygiene, especially the careful use of mosquito nets, an active program of health education should occupy a prominent place in this campaign.

In the Boys' Charity School, where the maximum rates of infection were found, the careful use of mosquito nets by all the pupils will help to bring down the incidence. The value of such a measure is strikingly illustrated by the experience of the School for the Blind, situated directly opposite, which although identically placed in regard to the prevalence of the intermediate host, and with sufficient infected persons in the neighborhood, is yet able to keep down the filarial incidence by careful use of mosquito nets for each pupil.

SUMMARY

1. Out of a total of 518 persons presenting all age groups of the population of Santurce, 7.7 per cent were positive for the microfilariae of *Wuchereria bancrofti*. The highest incidence was in the Boys' Charity School where 9.5 per cent of the pupils were positive.
2. The microfilarial rate in the Boys' Charity School shows a definite correlation to length of residence of the boys in the school, pointing to the fact that the School is an active endemic center of filariasis.
3. The clinical types of filariasis commonly met with in Santurce

and other parts of Porto Rico are filarial lymphangitis (filarial fever) and elephantiasis.

4. Only *Culex quinquefasciatus* was found infected with the larvae of the *Wuchereria bancrofti* and complete development of the larvae was seen in most specimens. Out of 572 mosquitoes examined, 5.4 per cent were infected with a maximum rate of 7.4 per cent in those captured in the Boys' Charity School.

5. Excellent breeding places for this mosquito are available around the two schools.

6. Filariasis is not a major public health problem in Porto Rico, but control measures are indicated in centers of heavy infection, such as Santurce and Puerta de Tierra.

7. A complete filarial survey of the Island, to map out areas requiring control and to define the intermediate hosts to be dealt with, followed by anti-mosquito measures on the lines of the "species control" in anti-malarial work, and a program of health education to promote personal hygiene are suggested as useful for the control of filariasis in Porto Rico.

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TABLE 1
SHOWING PERCENTAGE CLINICALLY POSITIVE, BLOOD POSITIVE AND TOTAL POSITIVE FOR FILARIASIS IN THE GROUP STUDIED *

| Institution | No. Exam. | Number Positive for micro-filariae | Percent positive for micro-filariae | Number positive clinically | Percent positive clinically | Percent total positive |
|---|-----------|------------------------------------|-------------------------------------|----------------------------|-----------------------------|------------------------|
| Boys' Charity School..... | 369 | 35 | 9.5 | 9 | 2.4 | 11.7 |
| School for the Blind..... | 21 | | | 2 | 9.5 | 9.5 |
| Out-patient dispensary at Santurce..... | 64 | 2 | 3.1 | 10 | 15.6 | 18.8 |
| District Hospital..... | 31 | 3 | 9.7 | 4 | 12.9 | 19.4 |
| Presbyterian Hospital..... | 33 | | | 1 | 3.0 | 3.0 |
| Total..... | 518 | 40 | 7.7 | 26 | 5.0 | 12.4 |

*Only two of the clinically positive cases were also positive for microfilaria. This has been taken into account in calculating the total positives.

TABLE 2
SHOWING CORRELATION OF INFECTION RATE WITH LENGTH OF RESIDENCE IN GROUP EXAMINED IN BOYS' CHARITY SCHOOL

| Number of years in school | Number Examined | Number positive for micro-filariae | Per cent positive for micro-filariae |
|---------------------------|-----------------|------------------------------------|--------------------------------------|
| 1..... | 42 | 2 | 4.8 |
| 2..... | 56 | 4 | 7.1 |
| 3..... | 81 | 5 | 6.2 |
| 4..... | 76 | 7 | 9.2 |
| 5..... | 47 | 5 | 10.7 |
| 6 and over..... | 67 | 12 | 17.9 |
| Total..... | 369 | 35 | 9.5 |

TABLE 3
SHOWING PERCENTAGE OF MOSQUITO INFECTION IN VARIOUS GROUPS STUDIED

| Name of place | Number of mosquitoes examined | Number infected | Per cent of mosquitoes infected |
|--|-------------------------------|-----------------|---------------------------------|
| Boys' Charity School..... | 435 | 27 | 6.2 |
| School for the Blind..... | 53 | 2 | 3.6 |
| Private houses around these schools..... | 72 | 0 | 0 |
| San Juan..... | 7 | 0 | 0 |
| District Hospital..... | 5* | 2* | 40.0* |
| Total..... | 572 | 31 | 5.4 |

*This was more in the nature of an experimental infection, since the mosquitoes were made to bite a known infected person in the hospital.