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ONCHOCERCIASIS IN SAN VICENTE PACAYA, GUATEMALA*

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Abstract. An epidemiological survey for onchocerciasis was carried out in the San Vicente Pacaya area of Guatemala. A total of 2,153 inhabitants were examined by a single skin snip, and 664 (30.8%) were positive for microfilariae. Slit lamp examination of the anterior chamber of the eye revealed microfilariae in 6.2%; the positive rate for microfilariae in the anterior chamber was proportional to the microfilarial density in the skin. The altitude-dependent character of onchocercal infection was shown in this mountainous area, suggesting that transmission occurs principally between 600 and 1,300 m. Of 1,217 persons examined simultaneously by skin snip and by palpation for nodules, 587 were positive by one or both methods; 101 infections were detected by onchocercal nodules only and these were usually in children or persons living in areas of low endemicity. It was concluded that both the skin snip and a search for nodules are required for accurately determining the prevalence of onchocerciasis in Guatemala.

Since the discovery of endemic onchocerciasis in Guatemala by Robles in 1915 the only control measure practiced in the campaign against this blindness-causing parasitic disease has been denodulization. However, several previous reports suggested that infection due to onchocerciasis was not affected by this measure in the endemic areas in Guatemala.[1-3] Recently, the Ministry of Public Health, Republic of Guatemala has evaluated the past results of the denodulization campaign in this country and concluded that a new research program to control the disease should be launched. For this research program, San Vicente Pacaya was selected as the pilot area for epidemiological, entomological, and clinical studies. Reported here are results of epidemiological surveys for onchocerciasis in this region carried out between June 1976 and May 1977.

MATERIALS AND METHODS

San Vicente Pacaya (SVP) is located at latitude 14°24′42″ N and longitude 90°32′18″ W on the southern slope of Mount Pacaya, an active volcano, between Guatemala City and Escuintla, and is in the Department of Escuintla. The altitude of this region ranges from approximately 300–1,800 m. The area of SVP occupies 236 km^2 and has 5,730 inhabitants (1973 census). The main area of SVP is drained chiefly by the Metapa and Aguacapa Rivers and their tributaries.

San Vicente Pacaya county (*municipio*) is composed of a municipal town which is also called San Vicente Pacaya and 37 plantations (*fincas*) and villages. Some of the latter are extremely small with populations of only 5–10 persons. The town of San Vicente Pacaya, at an altitude of 1,520 m, has a population of 3,135 which is equivalent to 54.7% of the total population of SVP county. People living in the town were exempted from this preliminary survey because of uncooperative responses and difficulty in analyzing the occupations of those working outside the area. On the other hand, the people living in plantations and villages and working close to their living areas were very cooperative. For this reason they were considered to be representative of the prevalence of autochthonous infection with onchocerciasis in SVP county.

Before conducting the survey, all families of SVP were visited by trained interviewers who

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registered location of the houses and names, ages, and sexes of occupants according to routine procedures used in the malaria eradication program.

Inhabitants more than 3 years of age in 19 villages and plantations of SVP and several plantations of surrounding areas were examined for infection by a single skin snip taken from the left scapular region according to the technique of Tada et al.,[4] by slit lamp examination of the anterior chambers of both eyes, and by palpation for nodules. Skin snips 3–4 mm in diameter were taken by using a needle and a surgical knife. Unteased snips were incubated in physiological saline for 1 h at room temperature. The number of microfilariae in 1 mm^2 of a skin snip was expressed as the microfilarial density (MFD). The anterior chambers of both eyes were examined by an ophthalmologist with a Zeiss slit lamp after mydriatic, but without massage. Experienced paraprofessionals (*brigadas*) examined the whole body for onchocercal nodules by palpation. The location of onchocercal nodules was recorded individually and nodules were later removed.

As the prevalence of onchocerciasis in Guatemala has been determined primarily by the nodule rate, it was of interest to compare the prevalence as determined by that method with that obtained by skin biopsy. In this way the present survey would give for the first time a more accurate and complete picture of the prevalence of onchocerciasis in a large area.

RESULTS AND DISCUSSION

Prevalence of onchocerciasis in SVP

A total of 2,153 inhabitants were examined and 664 (30.8%) were positive for *Onchocerca volvulus* microfilariae in skin snips. The microfilarial rate ranged from 0–90% in individual regions. When the microfilarial rates were plotted against the altitude of individual regions it was clear that the microfilarial rate was highest in villages and plantations situated between 600 and 900 m above sea level (Fig. 1). In the lowlands below 500 m and in the one village examined on the plateau over 1,700 m the microfilarial rate was considerably lower and the majority of positives found in these regions were male adults. The results obtained in Aldea San Jose Bejúcal and Chilar were omitted in the figure because no microfilarial positives were found among 115 inhabitants of the former village (440 m altitude) and in the latter area the houses were widely distributed from a low to a high altitude on the mountain. The results suggest that onchocerciasis transmission occurs in relatively limited areas situated between 600 and 1,300 m above sea level.

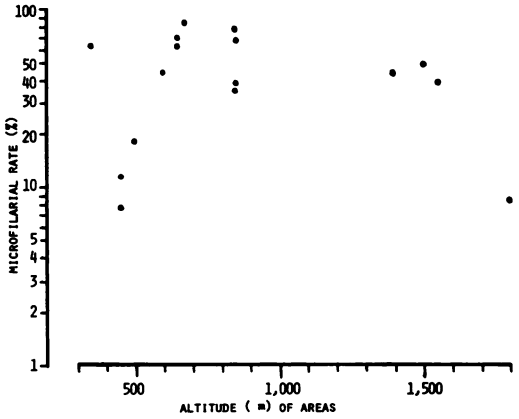

FIGURE 1. Relationship between microfilarial rate and altitude of 16 villages and plantations in San Vicente Pacaya.

Age and sex distribution of persons positive for microfilariae

Microfilaria-positive rates in males rose in proportion to age and the highest rate (65%) occurred in the 40- to 49-year age group (Fig. 2). In all age groups the rate in females was about one-half that in males.

Figure 3 depicts the difference of microfilarial densities by sex, according to the analytic method of Sasa.[5] When the microfilarial density corresponds to 50% (equivalent to 5 in probit) and cumulative percentage is used as an index, MFD_{50} is 0.9 for females and 3.2 for males, reading from the regression line. These data show that more frequent and heavier infections occur in males as compared with females. A similar tendency has been shown in previous reports from Guatemala.[3,6,7]

The differences in prevalence and intensity of infection between males and females may be due to occupational differences that determine degree of exposure to black fly bites and/or differences in susceptibility of the sexes to filarial infection,

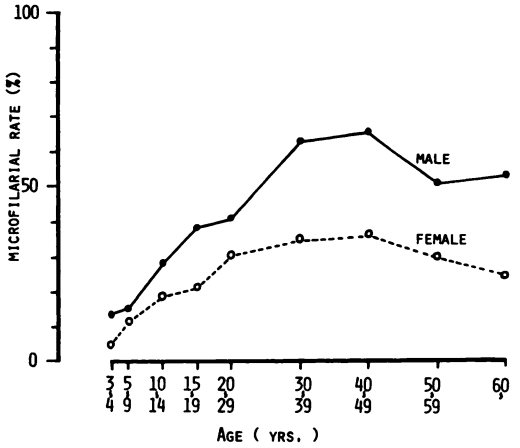

FIGURE 2. Age-sex distribution of positives for microfilariae among 1,150 males and 1,035 females in San Vicente Pacaya and surrounding areas.

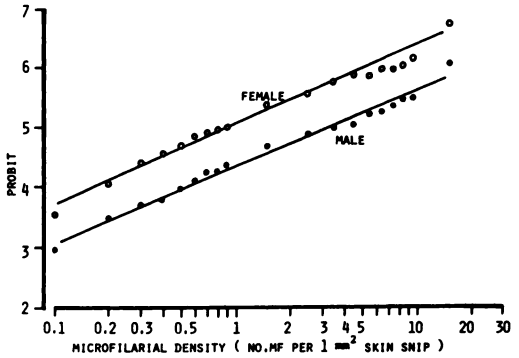

FIGURE 3. Cumulative percentage distribution of microfilarial positives by microfilarial density.

as shown by Ash for *Brugia pahangi* infection in jirds.[8]

Relation between microfilaria rate and nodule rate

There was a close correlation between microfilaria rate by single biopsy and nodule rate in the inhabitants of 18 villages and plantations of SVP and the surrounding areas (Fig. 4). The nodule-biopsy pattern obtained in SVP is similar to some extent to that shown by Buck for Guinea, West Africa.[9] A 50% microfilaria rate corresponded approximately to a 35% nodule rate in SVP, while in Guiana a 50% microfilaria rate corresponded approximately to a 16% nodule rate. This indicates that in Guatemala, unlike Guinea, in spite of the denodulization campaign many persons have nodules in which microfilariae can be detected in the skin. In some villages the nodule rate was higher than the microfilaria rate, especially in children, indicating that a sensitive index of infection in areas of low endemicity, or in young children or those exposed for the first time, is to find onchocercal nodules.

Examination of the anterior chamber of the eye

Both eyes of 1,217 persons were examined with a slit lamp and their scapular regions by skin biopsy; 76 (6.2%) had microfilariae in their anterior chambers (MFAC). MFAC were found in 14.9% of male patients and 9.6% of females. A clear correlation was found between increasing age and a rise in the positive rate, especially in males. There was also a clear correlation between the density of microfilariae in the skin and the positive rate for MFAC (Table 1). Only 5 persons (0.7%) were positive for MFAC of 732 who were negative by single skin snip examination, while 13 (35.1%) were positive of 37 whose microfilarial density (no. microfilariae/snip) was

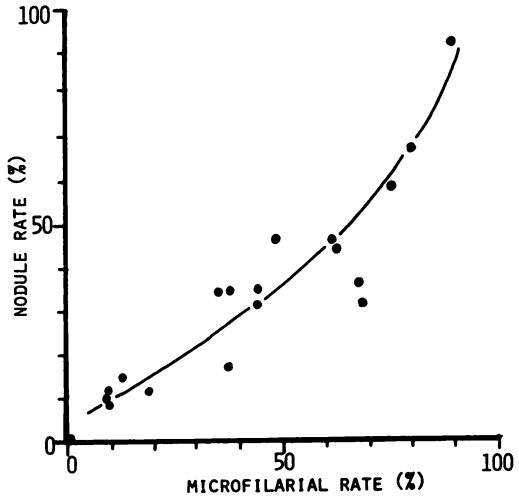

FIGURE 4. Relationship between microfilarial rate and nodule rate in San Vicente Pacaya and surrounding areas (2,887 biopsies).

TABLE 1

Relationship between the number of microfilariae of O. volvulus *per single skin snip (MFD) and microfilariae in the anterior chamber of the eye (MFAC)*

MFD	No. examined	No. with MFAC	% positive
0	732	5	0.7
1–10	166	5	3.0
11–50	151	23	15.2
51–100	63	13	20.6
101–200	52	13	25.0
201–300	16	4	25.0
301+	37	13	35.1
Total	1,217	76	6.2

301 or more. This shows that the number of microfilariae in the skin is closely related to the prevalence of microfilariae in the anterior chamber. In the ophthalmological survey, massage of the eyelids was not done before examination. This technique, initiated by Diallo and Loreal,[10] would probably enhance the detection of microfilariae in the eye.

Location of onchocercal nodules

During the present survey a total of 500 persons were found to have onchocercal nodules (Fig. 5); 56.5% of the nodules were found on the head (25.2% in the occipital and 22.1% in the parietal regions), 38.9% on the trunk, and 4.6% in other locations. This finding is similar to the results reported previously by Estrada et al.[11]

Comparison of diagnostic measures

We compared the diagnostic utility of three measures—single skin biopsy, palpation for nodules, and slit lamp examination of the anterior chamber of the eye. A total of 1,217 persons from SVP and surrounding areas were examined by all three techniques; 587 (48.2%) were found positive for onchocercal infection by at least one method (Table 2). Of those infected, the skin snip method detected 485 (82.6%) and palpation revealed 412 (70.2%). When both of these examinations are combined, 586 infections (99.8%) were diagnosed while only 0.2% of the infections were found by ophthalmological examination alone. While slit lamp examination of the anterior chamber is not a sensitive means of diagnosis of

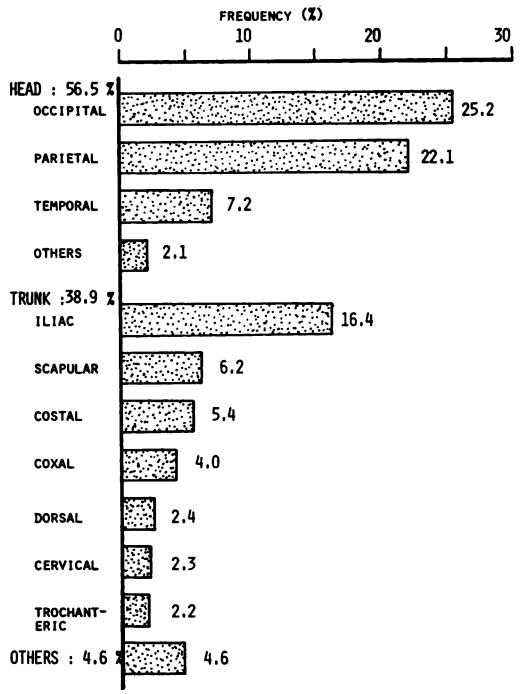

FIGURE 5. Location of onchocercal nodules in 500 persons from San Vicente Pacaya.

infection, the presence of microfilariae in the eye is an important sign of severe prognosis.

In the present survey, 101 (17.2%) infections were detected by nodules alone. In a separate study (Y. Aoki, unpublished), 801 nodules (91.8%) of 873 removed were of onchocercal origin microscopically.

The proportion of nodule positives among persons who were negative for microfilariae varied with the level of endemicity and with age. In areas of low endemicity (8–25% prevalence), 36.3% of all the positives had nodules alone, while the rate decreased to 17.5% in meso-endemic areas (35–50% prevalence) and to 9.2% in highly endemic areas (60+% prevalence) (Table 2). The frequency of persons showing only nodules decreased with increasing age: 45.0% in the age group below 4 years; 36.8% in children 5–9 years old; 23.1% in those aged 10–15 years; 14.8% in the group 16–30 years; and 12.2% in persons more than 31 years old.

In conclusion, diagnosis by single skin snip alone is not sufficiently sensitive, especially among

TABLE 2

Correlation of findings in 1,217 inhabitants of San Vicente Pacaya by skin snip method, palpation, and slit lamp examination of the anterior chamber with the level of endemicity

Diagnostic measures				No. (%) of individuals positive in relation to level of endemicity		
Skin snip (mf)	Palpation (nodule)	Slit lamp (mf)	No. cases	8–25%*	35–50%†	60+%‡
Positive	Positive	Positive	60	2 (2.5)	24 (9.3)	34 (13.6)
		Negative	251	20 (25.0)	108 (42.0)	123 (49.2)
	Negative	Positive	11	0	5 (1.9)	6 (2.4)
		Negative	163	29 (36.3)	71 (27.6)	63 (25.2)
Negative	Positive	Positive	4	0	3 (1.2)	1 (0.4)
		Negative	97	29 (36.3)	45 (17.5)	23 (9.2)
	Negative	Positive	1	0	1 (0.4)	0
		Negative	630	–	–	–
Total positive				80 (6.6)	257 (21.1)	250 (20.5)

* Fincas Cedro, San Nicolas, Chaguites.
† Fincas Amate, Hamburgo, Patrocinio, Santa Fe, Los Rios.
‡ Fincas San Jose Guachipilin, Alejandro, Caña vieja, Chorritos, Berlin, Chilcas, Guachipilin, Chilar.

infected children or persons lightly infected. Therefore, in Guatemala special attention should be paid to the detection of onchocercal nodules by palpation.

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REFERENCES

1. Bernhard, J. A., 1965. Twenty-five years of onchocerciasis control in Guatemala. *WHO ONCHO./INF./10.65.*
2. Figueroa M., H., 1974. Robles' disease (American onchocerciasis) in Guatemala. Pages 100–104 *in* Sci. Publ. No. 298, *Onchocerciasis in the Western Hemisphere.* Pan American Health Organization, Washington, D.C.
3. Figueroa M., H., and Guillioli, C. G., 1971. *Estado Actual de la Enfermedad de Robles (Oncocercosis Americana) en Guatemala.* Tailleres Graficos Galindo, Guatemala.
4. Tada, I., Iwamoto, I., and Wonde, T., 1973. Quantitative studies on the emergence of *Onchocerca volvulus* microfilariae from skin snips. *Jap. J. Trop. Med. Hyg., 1:* 13–24.
5. Sasa, M., 1976. *Human Filariasis.* University Park Press, Baltimore.
6. Garcia M., A., 1970. La oncocercosis en Guatemala. *Breve resumen preparado para informacion de los Asistentes al Congreso Nacional de Salud, Guatemala.*
7. Tada, I., Figueroa M., H., and Takaoka, H., 1974. Epidemiological studies on Robles' disease (American onchocerciasis) in Guatemala. *Jap. J. Trop. Med. Hyg., 2:* 35–51.
8. Ash, L. R., 1971. Preferential susceptibility of male jirds (*Meriones unguiculatus*) to infection with *Brugia pahangi. J. Parasitol., 57:* 777–780.
9. Buck, A. A., 1974. Epidemiologic features of onchocerciasis. Pages 35–45 *in* Sci. Publ. No. 298, *Onchocerciasis in the Western Hemisphere.* Pan American Health Organization, Washington, D.C.
10. Diallo, J., and Loreal, E., 1968. Le massage oculaire dans le diagnostic de l'onchocercose. *Bull. Soc. Med. Afr. Noire, 13:* 481–483.
11. Estrada S., C., Bernhard, J. A., Figueroa, L. N., and Garcia M., A., 1963. *Epidemiologia, Enfermedad de Robles.* Editorial Universitaria, Guatemala.