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## EPIDEMIOLOGICAL PATTERNS OF CUTANEOUS LEISHMANIASIS IN PANAMA

### III. ENDEMIC PERSISTENCE OF THE DISEASE

ARISTIDES HERRER AND HOWARD A. CHRISTENSEN

*Gorgas Memorial Laboratory, P.O. Box 2016, Balboa Heights, Canal Zone*

**Abstract.** Endemic persistence of cutaneous leishmaniasis is described in El Aguacate, a community established in the forest of central Panama about 75 years ago. Physiographic peculiarities partially isolate El Aguacate from other villages in the region. Some of the original forest environment has been preserved and man-biting species of phlebotomine sandflies were abundant as was the two-toed sloth, *Choloepus hoffmanni*, the principal reservoir host of *Leishmania braziliensis* in Panama. The inhabitants, as well as their dogs, were examined for natural leishmaniasis in 1969 and 1973. Mammals and phlebotomine sandflies were collected from 1968 to 1973 in a search for reservoir hosts and potential vectors of the disease. Similar studies were undertaken in two nearby villages during 1965 and 1969. *L. braziliensis* has persisted for many years in El Aguacate, and infection is acquired during childhood. Dogs also were found naturally infected, and the two-toed sloth showed yearly infection rates up to 47.8%. Parasites were demonstrated from a night monkey, *Aotus trivirgatus*.

An outbreak of cutaneous leishmaniasis among people of a small settlement, as discussed in a previous paper,<sup>1</sup> is the most common epidemiological pattern of the disease in Panama. A second epidemiological pattern is characterized by the incidental or sporadic appearance of the infection among humans and dogs that periodically enter forested areas.<sup>2</sup> The involvement of persons of any age and either sex, as well as the rapid disappearance of the disease from the settlement, have been considered as principal characteristics of the first pattern, and the acquisition of the disease almost exclusively by male adults in the second.

Rarely, epidemiological patterns of cutaneous leishmaniasis differ significantly from the two types mentioned above. One such exception, however, is characterized by the persistence of the infection within a community for long periods of time, and the occurrence of the disease mainly among children. We had the opportunity of observing such a pattern of cutaneous leishmaniasis in a community established in central Panama many years ago, and this paper reports the results of our studies.

#### MATERIALS AND METHODS

##### *The study area*

The community of El Aguacate is located in the foothills of Trinidad Mountain, about 45 airline kilometers west of Panama City. Human dwellings are scattered throughout the small El Aguacate valley from the base of Trinidad Mountain, north to the Trinidad river. At one end of the El Aguacate valley there is a creek which becomes a torrential river during the rainy season. Due to this particular topography El Aguacate has remained somewhat isolated from other nearby villages in the region.

According to the local people the first settlers established the community at least 75 years ago. All were relatives of a few families. From the beginning their fundamental occupation has been self-subsistence agriculture, which has been carried out with only partial destruction of the forest. Moreover, they have planted fruit trees, mainly citrus as well as coffee plants, which have helped to preserve the forest environment (Fig. 1). These conditions supported the presence of many species of forest mammals and a large population of phlebotomine sandflies.

Construction of houses is similar to those found in most of the small communities established in





FIGURE 1. Landscape of El Aguacate study area. Homesteads are hidden by the secondary forest and citrus orchards present throughout much of the small valley. A recently constructed road is shown in the foreground.

the Panamanian forest. They are palm-thatched houses with stick-mud walls. Most of the houses are surrounded by vegetation and some of them are shaded by tall trees. Houses are periodically sprayed with insecticides by a government agency.

#### *Epidemiological census*

Following the study methods described previously,<sup>1</sup> people of El Aguacate were interviewed and examined for cutaneous leishmanial infections in May 1969 and again in May 1973. At the time of the latter census a road for motor vehicles was under construction to El Aguacate. This resulted in an increased immigration of people from surrounding areas. Also agricultural activities increased markedly, necessitating the clearing of additional forested areas for planting crops.

To compare the results of the first census at El Aguacate, similar censuses were made in the communities of Caimito and La Valdesa in February 1970. Caimito, La Valdesa and El Aguacate are located in the same region, within a few kilometers of each other, and were settled about the same time. Nevertheless, Caimito and La

Valdesa differ markedly from El Aguacate because most of their houses are closely grouped into compact villages completely cleared of vegetation. In addition, a well traveled road has facilitated access to both of these villages for many years.

#### *Search for leishmanial infections among animals*

As part of a long-term project to evaluate the reservoir hosts of human cutaneous leishmaniasis in the Republic of Panama, the study of feral mammals from El Aguacate was initiated in 1967. With the discovery of high infection rates in the two-toed sloth, *Choloepus hoffmanni*, starting in 1968 the studies were restricted almost entirely to this edentate. Live specimens of two-toed sloths were collected on a regular basis from El Aguacate from 1968 to 1973, and processed in the laboratory. In addition, an extensive examination for leishmaniasis was made of all dogs in the community during the censuses taken in 1969 and 1973.

Natural leishmanial infections were investigated

TABLE 1

Comparative results of the epidemiological census carried out in El Aguacate (1969) and La Valdesa-Caimito (1970)

Number of persons	El Aguacate			La Valdesa-Caimito		
	Under 8 years	8 years and up	Total	Under 8 years	8 years and up	Total
Examined	59	115	174	90	147	237
With leishmanoid scars	9	59	68	2	62	64
With active lesions	4	1	5	0	3	3
With no history of leishmaniasis and absence of active lesions	46	55	101	88	82	170

also among dogs and certain feral mammals in Caimito and La Valdesa.

#### Entomological investigations

Limited numbers of phlebotomine sandflies were collected to determine their population composition and the anthrophilic species present. Most of the specimens were collected in CDC miniature light traps. Flies were also collected from tree buttresses. Potential vector species were taken in man-biting and horse-baited collections.

### RESULTS

#### Epidemiological census

Results of the 1969 El Aguacate census and the 1970 La Valdesa and Caimito censuses are presented in Table 1. The data represent a sample of the population as it includes only those individuals from whom we were able to obtain complete information.

About 200 persons were interviewed during the 1973 El Aguacate census, but data gathered only

from 136 of them were considered as valid and complete. Approximately half of these were under 8 years of age. Two active cases were found among the children and none in the settlers over 8 years of age. Also 1 (2%) of 49 dogs examined proved to be infected.

#### Leishmanial infections among animals

Table 2 contains information related to the search for natural infections with *Leishmania braziliensis* among feral mammals and dogs in El Aguacate and La Valdesa-Caimito during 1968-70. Yearly incidence of infection with *L. braziliensis* of the two-toed sloth during 6 years (1968-1973) of study is shown in Table 3.

#### Phlebotomine sandflies

A total of 606 sandflies comprising 15 species was collected in El Aguacate, La Valdesa and Caimito. Anthrophilic species taken biting man and in horse-baited collections are listed in Table 4. Phlebotomine sandfly species incriminated as vectors of *L. braziliensis* in Panama<sup>3</sup> were present in all three communities studied.

TABLE 2

Mammals examined for natural infections of *Leishmania braziliensis* in El Aguacate and La Valdesa-Caimito during 1968-1970

Animals examined	El Aguacate		La Valdesa-Caimito	
	No. examined	No. infected	No. examined	No. infected
Dogs, <i>Canis familiaris</i>	35	1	49	0
Two-toed sloths, <i>Choloepus hoffmanni</i>	92	20	25	5
Night monkeys, <i>Aotus trivirgatus</i>	5	1	8	0
Other feral mammals, mainly rodents	129	0	44	0
Totals	261	22 (8.4%)	126	5 (3.9%)



TABLE 3

*Leishmanial infections of the two-toed sloth, Choloepus hoffmanni, in El Aguacate during 1968-1973*

Year	No. sloths		% infection rate
	Examined	Infected	
1968	48	10	20.8
1969	21	4	19.0
1970	23	6	26.0
1971	23	11	47.8
1972	22	3	13.6
1973	10	4	40.0
Total	147	38	25.9

## DISCUSSION

Human cutaneous leishmaniasis was observed in El Aguacate at a low infection rate during the entire study period, with active cases restricted to young children. The continuous occurrence of human infections in this locality after many years of habitation is a result of several factors, mainly preservation of part of the original forest environment, abundance of man-biting species of phlebotomine sandflies, presence of the two-toed sloth, and the rather isolated situation in which El Aguacate community existed until 1973. All these factors helped to establish the particular and propitious ecological situation for the endemic persistence of the human infection. This is a rare epidemiological pattern for cutaneous leishmaniasis in Panama, since the usual extensive deforestation associated with the establishment of jungle communities generally results in ecolog-

ical changes unfavorable to sandfly vectors and reservoir hosts, and cutaneous leishmaniasis eventually disappears.

Results of the first (1969) El Aguacate census (Table 1) show that 4 of the 5 active leishmaniasis cases were in children under 8 years of age. In addition, 9 other children of this age group had leishmaniasis scars from previous infections. These 13 (22%) children out of 59 in this age group were affected by the disease at the time of the first census. Additionally, in March 1973 at the termination of our studies, two new active cases were again observed in young children whereas no new cases were found among adults. Therefore, the focus of endemicity very likely encompassed the homesteads themselves. The persistence of the disease among children possibly was due to the presence of the two-toed sloth with high infection rates (47.8% in 1971, Table 3) in the proximity of homesteads during the entire study period. Also, the two dogs with natural cutaneous leishmaniasis were found in homesteads with active human cases.

The results of the El Aguacate census contrast with those of La Valdesa and Caimito. Ages of the three active cases seen in these villages were 9, 24 and 36 years. The latter two individuals informed us they frequently visited localities far from their home villages, and it is likely that they became infected during one of these trips.

Results of the search for natural leishmanial infections among feral mammals (Table 2) emphasized the great importance of the two-toed

TABLE 4  
*Results of man and horse-baited sandfly collections*

<i>Lutzomyia</i> species	Collected in					
	El Aguacate		La Valdesa-Caimito		Total collected	
	No.	%	No.	%	No.	%
<i>L. cruciata</i>	2	0.6	3	2.3	5	1.1
<i>L. gomezi</i> *	236	68.8	27	20.3	263	55.3
<i>L. panamensis</i> *	1	0.3	1	0.8	2	0.4
<i>L. sanguinaria</i> *	6	1.8	26	19.5	32	6.7
<i>L. shannoni</i>	2	0.6	2	1.5	4	0.8
<i>L. trapidoi</i> *	66	19.2	51	38.3	117	24.6
<i>L. ylephiletor</i> *	30	8.7	23	17.3	53	11.1
Total	343	100.0	133	100.0	476	100.0

\* Species incriminated as vectors of *L. braziliensis* in Panama.

sloth as the main reservoir responsible for the maintenance of the infection in nature. Sloths with high infection rates (47.8% in 1971, Table 3) were common in the proximity of homesteads in El Aguacate during the entire study period, which may explain the persistence of the disease among both children and dogs. Even in La Valdesa and Caimito, where human infections are rare, sloths which were captured in their vicinities showed a high (20%) infection rate. The single night monkey, *Aotus trivirgatus*, and two dogs found in El Aguacate with *L. braziliensis* may possibly act as ancillary reservoir hosts of this species of *Leishmania*. Rodents, as in other areas of central Panama where *L. braziliensis* is present, were not involved in the ecology of human cutaneous leishmaniasis in El Aguacate.

Three potential sandfly vectors species, *Lutzomyia gomezi*, *L. trapidoi* and *L. ylephiletor* were present in sufficient numbers to be suspected as vectors of *Leishmania* in El Aguacate. The same three species, as well as *L. sanguinaria*, probably play a role in maintaining the disease among two-toed sloths in the forests surrounding La Valdesa and Caimito.

Wild-caught *L. ylephiletor* and *L. trapidoi* have been shown by the precipitin method to feed on edentates (probably sloths) in El Aguacate.<sup>4,5</sup> Laboratory-reared *L. trapidoi*, *L. gomezi* and *L. sanguinaria* readily feed on two-toed sloths under laboratory conditions.<sup>9</sup>

The preservation of a portion of the original forest, as well as the presence of mature citrus orchards and some secondary forest vegetation throughout the community of El Aguacate, provided ecological conditions favorable to the maintenance of reservoir hosts and vector sandfly species. All of these factors contribute to the epidemiological pattern of persistent endemism. This pattern is characterized by the prevalence of active cases among children in the community besides the presence of leishmanoid scars among the adults.

Although leishmaniasis probably has been a fact of life in the community for most of its 75 years, the ecological impact resulting from the completion of a road into the area may change this in the near future. Increased deforestation activities by new immigrants to provide more farm land may soon disrupt the transmission cycle of *Leishmania* which will lead to the disappearance of the disease.

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