

EPIDEMIOLOGICAL ASPECTS OF AMERICAN CUTANEOUS LEISHMANIASIS IN A PERIURBAN AREA OF THE METROPOLITAN REGION OF BELO HORIZONTE, MINAS GERAIS, BRAZIL

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*In order to characterize the epidemiology of American Cutaneous Leishmaniasis (ACL) in a periurban area of the municipality of Sabará in the metropolitan region of Belo Horizonte (MRBH), an area until then considered free of the disease, a cross sectional survey was undertaken in 1990. The survey of the population consisted of 1119 interviews and 881 clinical examinations using Montenegro's skin test (MST). A low prevalence (3.7%) of positive MST was encountered. The disease had been occurring in the area for about 20 years in the form of sporadic cases. The predominant species of sandfly both in domestic areas and nearby areas of secondary vegetation was *Lutzomyia whitmani*. A canine survey of delayed hypersensitivity to the antigen P10,000 identified only one dog with a positive reaction out of 113 examined.*

The transmission of ACL in MRBH was confirmed. The occurrence of the disease in women, children and individuals with no contact with forest areas as well as the presence of potential vector species in the domiciliar environment, suggests the transmission of the disease in this environment.

Key words: cutaneous leishmaniasis – epidemiology

American Cutaneous Leishmaniasis (ACL) has occurred in the state of Minas Gerais since the middle of the century with outbreaks related to deforestation for road construction, as well as for agricultural development (Orsini, 1945; Martins et al., 1956; Furtado et al., 1966). In the last two decades, however, the epidemiological behavior of the disease has changed from that initially described in various states of Brazil, with the occurrence of outbreaks in long settled areas, practically devoid of forest (Araújo Filho, 1978; Mayrink et al., 1979; Sabroza, 1981; Oliveira-Neto et al., 1988).

Since 1987, native cases of ACL have been reported in some towns within the metropolitan region of Belo Horizonte (MRBH) (Passos et al., 1990). From October 1988 to February 1989, three cases of ACL occurred in a shanty town in the municipality of Sabará, which is about 20 km from the center of the state capital. The three patients denied travelling to or

staying in other areas for at least two years prior to the onset of the disease.

As the MRBH had always been considered to be free of ACL, it was decided that clinical and epidemiological studies should be undertaken with the view to employing control measures.

MATERIALS AND METHODS

Study area – The study area, the shanty town of Vila Rica in Sabará, MRBH, is situated at 19°53'59"S and 43°49'06"W with an altitude varying from 700 to 799 metres (Sepplan, 1990). The average temperature in the year in which the study was undertaken varied between 18.8 °C and 24.6 °C with a relative average air humidity of 68.7%. Monthly rainfall varied between 0.5 mm to 465.7 mm peaking in November and December (Departamento de Meteorologia, 1991).

The MRBH is not a endemic area for American Visceral Leishmaniasis or Chagas Disease.

Two hundred and sixty six buildings (of which 235 were private houses) containing a population of 1,153 inhabitants (4.9 inhabitants/house) were mapped.

Beside the urban area are plots of secondary vegetation separated by waste land.

Populational survey – The whole area was mapped and censused and the houses were visited by a single interviewer. Information concerning the standard of living and family income was collected. The personal interviews obtained the following information: name, date of birth, sex, colour, profession, time of residence, trips undertaken, history of cutaneous lesions with a duration of more than 30 days and previous treatment for ACL.

Montenegro's skin test (MST) – Due to the absence of a local medical center, all the inhabitants were invited to convene in a school for a clinical examination and MST to be undertaken. The individuals were examined for cutaneous lesions or scars suggestive of ACL.

The MST was undertaken with those inhabitants of more than one year of age, using antigen prepared from suspensions of dead *Leishmania* promastigotes, obtained from the Institute of Biological Sciences of the Federal University of Minas Gerais, with a protein nitrogen concentration of 40 µg/ml (Melo et al., 1977). The cutaneous response was measured 48 hr following the intradermal injection of 0.1 ml of antigen into the anterior face of the right forearm previously disinfected with alcohol. A cutaneous reaction, measured using a pen (Sokal, 1975), of greater than or equal to 5 mm was considered positive (Marzochi et al., 1980).

Characterization of clinical cases – All inhabitants with a history of cutaneous lesions of more than 30 days, confirmed by clinical examination as scarred or active lesions and a positive MST were considered to be clinical cases.

All inhabitants with positive MST who had never left the area and who did not present cutaneous lesions at clinical examination as well as clinical cases resident in the area who denied routine visits to other areas and who had not travelled for at least two years prior to the onset of the lesion were considered to be native infections.

Entomological survey – Weekly captures of insects were undertaken in the non-urbanized area beside the shanty town between August 1989 and August 1990. A light trap (Falcão, 1981) were placed in four areas, 100, 300, 800 and 1,000 m from the shanty town, between 5 and 6 pm and phlebotomus collected the next day at 8 am.

Captures within and outside the houses were made between March and April of 1990 using light traps as well as manual captures made with a Castro aspirator (Barretto & Coutinho, 1940).

Captured specimens were transported within the trap to the laboratory where they were killed with ether. The sandflies were separated from the other insects and mounted in Berlese liquid and then identified using specific descriptions, taxonomic keys and by comparison with species of the standard collection. The classification adopted in this work was that proposed by Martins et al. (1978).

Canine survey – The following data was recorded for dogs in the area: sex, age, origin, time of residence in the area, hunting activities within or outside the area.

Cutaneous lesions were looked for on all dogs and ulcers with diameters of greater than or equal to 5 mm on any part of the body or nodules on areas of coat loss were considered to be suspect lesions of ACL (Falqueto et al., 1986).

All dogs were skin tested with the antigen P10,000, a protein fraction of *L. braziliensis*, produced by the Public Health National School from Oswaldo Cruz Foundation. The reaction was measured 48 hr after the inoculation of 0.1 ml of antigen on the inner side of the right rear thigh previously disinfected with alcohol. A cutaneous response with a diameter of greater than or equal to 5 mm was considered positive (Marzochi & Barbosa-Santos, 1988).

Statistical analysis – Simple frequency distribution and non-parametric tests (chi-square and the Fisher's test) were used to study the populational data.

RESULTS

The local population – The distribution of the houses was not planned and they were located along unpaved streets. The majority

are brick built (99.5%), with electricity (97.2%), piped water (53.3%) but there is no sewage system. There is no refuse collection, which remains exposed in empty lots in 99.% of the houses. Fruit trees are present in 97.2% of the houses. There is a great variety of domestic animals: 142 dogs, 86 cats, 591 chickens, 68 pigs, 53 ducks, ten goats, ten cows and nine horses. Rats and opossums were reported in 45.6% and 25.3% of the houses respectively.

Interviews were undertaken with 1,119 individuals (97% of the local population), of whom 547 were male and 572 female, 179 white and 940 non-white, with ages ranging between one month and 83 years with a median of 22 years. 390 persons were born in the neighborhood, 393 were from other neighborhoods of Belo Horizonte and 33 from other towns of the MRBH. The other 303 inhabitants were from various towns in the interior of the state.

The distribution by age group showed 41.3% of the individuals to be less than 15 years old, 57.1% to be between 15 and 64 and 1.6% to be 65 or more.

The distribution by occupation showed 224 (20%) to be pre-school infants, 289 (25.8%) to be school children, 145 (13%) to be housewives and 461 (41.2%) unskilled workers. There was no report of any professional activity that required contact with forest areas (hunting, fishing, etc). Data concerning family income were obtained in 216 homes showing that 13 (6%) families received less than the minimum salary (US\$ 42), 130 (60.2%) between one and two minimum salaries, 60 (27.8%) between three and four and 13 (6%) more than 5 minimum salaries.

Skin test (MST) survey – Of the 1089 people interviewed of one year or older, 881 (80.9%) presented for examination. With respect to age, 402 people between one and 14 years-old out of a total of 431 and 479 people older than 15 years out of a total 658 presented for examination ($x^2 = 69.3$, $p < 0.01$). With respect to sex, 409 men out of a total of 534 and 472 women out of a total of 555 presented for examination ($x^2 = 12.0$, $p < 0.05$). There was thus a selective loss of inhabitants with respect to age and sex.

Thirty two individuals (3.7%) presented a positive MST. The presence of cutaneous lesions with duration of more than 30 days were

observed in 23 (71.8%) individuals. Seven individuals with positive MST did not have any form of lesion or perceptible scar in the clinical exam, one individual reported a history of visceral leishmaniasis and one did not permit a clinical examination. No individual with negative MST presented suggestive scars. No individual presented an active lesion at the time of the survey.

Human infection – Of the 17 inhabitants with infections considered to be native, six were male and 11 female, two were white and 15 non-white, with age varying between six and 46 years ($\bar{x} = 23.7$ years). There were four cases in adolescents (13, 13 15 and 16 years) and three cases in children (6, 9 and 9 years). Statistically significant differences were not found in these variables (sex, age and colour) between these individuals and the rest of the examined population (Table I).

TABLE I

Comparison of individual characteristics of the cases with native infection and the negative MST population of Vila Rica shanty town, Sabará, 1990

Variables	Negative MST n = 827		Native cases n = 17
Sex			
Male	383		07
Female	444		10
	$x^2 = 0.03$	$p = 0.861$	
Age			
1-14	383		05
> = 15	444		12
	$x^2 = 0.33$	$p = 0.567$	
Colour			
White	126		02
Non-white	701		15
	Fisher	$p = 0.510$	
Length of residence			
< = 5 years	397		01
> 5 years	430		16
	$x^2 = 10.23$	$p = 0.001$	

x^2 : Yates corrected chi-square.

Of the 14 native cases, seven presented lesions on the lower limbs, four on the upper limbs, two on the back and one individual with a cutaneous lesion on the face and on the back. The onset of lesions were reported as: one in 1971, one in 1978, one in 1982, three in 1983, six in 1988 and two in 1989. Three

TABLE II

Species of sandflies captured at four sites in the non-urbanized area beside the Vila Rica shanty town, between August/89 and August/90

Species	100 m ♂/♀	300 m ♂/♀	800 m ♂/♀	1000 m ♂/♀	Total ♂/♀
<i>Lu. whitmani</i> ^a	6/5	4/1	98/147	1/3	109/156
<i>Lu. monticola</i>	0/4	0/1	0/ 28	0/2	0/ 35
<i>Lu. fischeri</i> ^a	0/0	0/0	0/ 3	7/0	7/ 3
<i>Lu. longipalpis</i>	1/2	0/0	0/ 0	0/0	1/ 2
<i>Lu. missionensis</i>	0/0	0/1	1/ 1	0/0	1/ 2
<i>Lu. lloydi</i>	0/0	0/0	2/ 1	0/0	2/ 1
<i>Lu. intermedia</i> ^a	0/1	0/0	0/ 0	0/0	0/ 1
<i>Lu. sordelli</i>	0/0	0/0	0/ 1	0/0	0/ 1
<i>Lutzomyia</i> sp.	0/0	0/0	0/ 2	0/0	0/ 2
Total	7/12	4/3	101/183	8/5	120/203

a: potencial vector species.

individuals who had never left the study area presented positive MST and the absence of lesions on clinical examination.

The distribution by time of duration of lesions of individuals with positive MST showed four native cases with duration between 30 and 60 days, two native cases between 60 and 90 days, one case between 90 and 180 days and five cases with time of duration longer than 180 days. Two people did not remember the time of duration of lesions.

Of the 14 native cases, five were treated with pentavalent antimonials, four reported cure of the lesion only after non-specified medication and five reported spontaneous cure of the lesion.

The characteristics of the houses (type of built, water supply, sanitary installations, illumination, insect protection, fruits near to houses) where at least one native case lived were compared with the characteristics of the other houses without significant differences being found. Comparison between the time of residence of the examined population and the individuals with native infection showed a statistically significant difference, with an odds-ratio of 14.77 (2.06 < OR < 300.2, Cornfields confidence limits of 95%) for the people who lived more than five years in the area (Table I). The existence of concomitant family cases (two in one house and three in another) in the same street was observed.

Entomological survey – The species captured in the non-urbanized area are presented

in Table II, discriminated by sex and site of capture. Three hundred twenty three specimens of sandflies were collected, representing eight different species of the subfamily *Phlebotominae* (Diptera, *Psychodidae*). The commonest species was *Lutzomyia whitmani*, with 265 (82.04%) specimens captured.

In the 109 houses where light traps were placed outside the houses, two males of *Lu. whitmani* were found. Of the 74 houses where light traps were placed inside the houses, seven (9.7%) were positive, with 14 specimens of *Lu. whitmani* (12 males and two females), three specimens of *Lu. longipalpis* (two males and one female), one female of *Lu. lenti* and one female of *Lu. migonei*. Of the seven houses where the capture was positive, four did not use any protection against insects and three used repellents. In the 108 houses where manual capture was undertaken inside the houses, one female of *Lu. longipalpis* and one male of *Lu. whitmani* were found in different houses.

Canine survey – Of the 142 dogs in the area, 113 dogs from 75 houses were examined (79.5%), 65 males and 48 females, with an average age of 30 months.

One hundred and eight dogs were from the area with only five coming from Belo Horizonte city. No dogs were taken to hunt or to another activities outside the house.

Seven dogs presented ulcerated lesions on different parts of the body, two in the cervical region and five on the paws, with a duration unknown by their owners. Six dogs presented

uncharacteristic lesions on various parts of the body.

One hundred and thirteen animals were skin tested, of which in six (5.3%) cases a reading was not made. Only one dog, with an ulcerated lesion on the hind leg, presented a positive reaction. As it was put down by the owners, more conclusive examinations could not be performed.

DISCUSSION

The Vila Rica shanty town, ironically called "Rich Village" has similar characteristics to various areas on the outskirts of large Brazilian urban centers. Throughout the neighborhood there is a complete absence of basic services such as paved streets, sewage and refuse collection. There is no medical center in the locality which has never been visited by the health authorities. The analysis of professional activities showed a preponderance of low skilled manual labour and consequently a low income. The age profile revealed a predominance of young people.

Prevalence of ACL – The prevalence of positive MST (3.7%) can be considered low in comparison to other studies in endemic areas (Aston & Thorley et al., 1970; Araújo Filho, 1978; Dias, 1982; Jones et al., 1987). Nevertheless, surveys in these areas are usually undertaken when outbreaks of ACL occur.

The frequency of ACL differs with relation to the age of the patient. In studies undertaken in areas of deforestation (Orsini, 1945; Pessoa & Barretto, 1948; Forattini et al., 1959) the majority of patients are between 20 and 40 years old. In rural areas of established inhabitation and periurban areas (Araújo Filho, 1978; Mayrink et al., 1979; Sabroza, 1981; Dias, 1982; Oliveira-Netto et al., 1988) the disease occurs in all age groups, affecting children with a high frequency. In the study area, the disease occurred in all age groups, with a predominance of native infection in the 15 to 44 year old age group.

Despite the finding of infected children, the greater percentage were adults, which raises the possibility of transmission occurring in the extradomiciliar areas due to occupational activities. However, the absence of activities related to forest areas shows that possibly the ACL in the area is not characterized as an

occupational risk of individuals who undertake work in the forest.

The occurrence of the infection in both sexes, with a greater number of women infected, in children and in individuals without direct contact with forested areas are epidemiological characteristics that suggest the occurrence of infection in the peridomiciliar or domiciliar environments.

Of the individual characteristics analyzed, only the time of residence was related to the prevalence of infection, a fact that also suggests the house as a risk factor for infection.

Characteristics of ACL in the area – Until the present study there has been little information concerning ACL in MRBH. The data derived from this survey not only suggest the existence of ACL in the region, but were also important for the characterization of the epidemiological behavior of the disease in the periurban area of Sabará town.

It is of interest to note that of the 23 individuals with positive MST and history compatible with ACL, only six reported the disease in the initial interview. The other 17 (73.9%) only remembered the lesions when discussed during the clinical examination. Retrospective inquiries of morbidity do not always detect the real prevalence of the disease, the further in the past the event the less the likely it is to be reported (Lilienfeld & Lilienfeld, 1980). In the case of ACL, as well as poor memory of past events, the problem is exacerbated since the disease has few repercussions, in most cases not requiring the individual to cease their routine activities or causing serious sequelae. Said (1984), in analyzing the perception of ACL by inhabitants of the periurban area of Rio de Janeiro, concluded that as the incidence of the disease is not high, the inhabitants in general minimise its importance.

In the year of the present study, no cases of active lesions were encountered in man, which made it impossible to characterize the parasite responsible for the infection in the area. Strains of native cases of ACL in other area of MRBH (Passos et al., 1991a) have been previously characterized by restriction endonuclease analysis of kDNA as *Leishmania (Viannia) braziliensis*. A few strains originating from other areas of Sabará town are being maintained in culture and hamsters for characterization.

The existence of cases of spontaneous cure confirm the observation of studies in other areas in which individuals with positive MST and scared lesions without any form of specific treatment were found (Nery-Guimarães, 1955; Forattini & Oliveira, 1957; Menezes et al., 1974; Araújo Filho, 1978; Marzochi et al., 1980).

The presence of positive MST in the absence of active lesions or scars may be due to imperceptible lesions or indeed a subclinical infection as has previously been described (Menezes et al., 1972; Araújo Filho, 1978; Marzochi et al., 1980; Scorza et al., 1985; Arzubiaga et al., 1984; Oliveira-Neto et al., 1988).

The distribution by probable date of infection of the native cases demonstrated that ACL had started to manifest itself in the region at least 20 years ago, always in the form of sporadic cases. ACL also occurs in sporadic cases in various areas of the country with intensification of transmission occurring from time to time (Araújo Filho, 1978; Sabroza, 1981; Aguillar et al., 1987; Lago et al., 1990).

Studies of transmission – In comparing the species captured in 1990 with the studies undertaken between 1957 and 1969 (Martins et al., 1978) there was a reduction in the number of species of sandflies, although three species were described in the area for the first time: *Lu. intermedia*, *Lu. longipalpis* and *Lu. sordelli*. Lainson (1983), in analysing the ecological and epidemiological characteristics of areas in the south of Brazil, concluded that in these areas, due to the drastic changes in the environment caused by deforestation, the primitive sandflies had disappeared or become so rare that their function in transmitting the disease diminished, with more robust species adapting to the new ecological conditions. This is probably the case for *Lu. pessoai*, *Lu. migonei*, *Lu. whitmani*, *Lu. fischeri*, *Lu. intermedia* and *Lu. longipalpis*. With the exception of the first, all these species were captured in the study area.

In the already greatly altered environment of the study area, the predominance of *Lu. whitmani* both in the non-urbanized areas and in the domestic environment suggests not only the importance of this species as a possible vector in the region but also the possibility of its adaptation to domestic conditions. The specimens captured in the home environment may

have been captured by chance when they were migrating from the secondary vegetation close to the neighborhood to feed. Nevertheless, the presence of males in the domestic environment suggests the existence of natural breeding colonies close to these places, since the males do not feed on blood. Forattini et al. (1972) described the occurrence of *Lu. whitmani* in banana orchards and suggested the adaptation of these species to environments modified by man. *Lu. whitmani* has also been noted as the predominant species in secondary forests in other municipalities of MRBH (Passos et al., 1991b) where native cases of ACL have occurred.

Based on only the entomological evidence, we can conclude that the situation that exists in Sabará town shows similarities with those in Vale do Rio Doce (Mayrink et al., 1979) and in the states of Bahia (Rosa et al., 1988), Ceará (Azevedo et al., 1990) and Goiás (Lustosa et al., 1986), where there is a predominance of *Lu. whitmani*.

Canine infection – Wild mammals are the principal reservoirs of the disease in various endemic areas of the country (Forattini, 1960; Nery-Guimarães et al., 1966; Simões-Barbosa et al., 1970; Dias, 1982). With the spread of ACL into long established colonized areas practically devoid of vegetation, the number of natural infections found in domestic animals, particularly dogs, has increased (Brumpt & Pedroso, 1913; Dias, 1975; Barreto et al., 1984; Falqueto et al., 1986; Pirmez et al., 1988).

In the study area, the presence of positive skin test and an ulcerated lesion in one dog suggests the presence of the disease in this domestic animal. Nevertheless, further studies are required to determine the reservoirs in this area.

ACL in a periurban area – The zoonotic character of ACL implies in the existence of various natural environments, with different vegetation, animal reservoirs and vectors, human infection being of accidental or fortuitous nature due to the voluntary invasion of certain environments by man.

Adaptation of the parasite to new hosts and reservoirs, as well as potential vectors and modified environments, enable the transmission of the disease to take place close to hu-

man habitation. This raises concern in terms of the possibility of adaptation of ACL to artificial ecotopes, with wider distribution than natural ecotopes, implying a great potential for dispersion particularly in view of the health conditions of Brazilian cities (Sabroza, 1981).

Transmission of ACL in the domestic environment ends the association of risk of infection with individual activities. Sabroza (1981), in discussing ACL in a periurban area of Rio de Janeiro, observed that "instead of a disease tending to disappear, characterized by sporadic infection in individuals who enter the forest, it has become more of a frequent damage which affects the inhabitants of areas underprivileged in terms of medico-sanitary conditions whether in the countryside or the periphery of metropolitan regions".

The possibility of domestic transmission of ACL in Sabará town and the existence of the disease in other periurban areas of MRBH raises the expectation of both a rise in the number of cases in the region and in the occurrence of outbreaks.

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