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Epidemiological evaluation of Chagas disease in a rural area of southern Bolivia

Jean-Philippe Chippaux[a,*], Jorge R. Postigo[a], José A. Santalla[b], Dominique Schneider[c], Laurent Brutus[c]

[a] *IRD UR010, Team 'Mother's and Child's Health in Tropical Environment', Institut de Recherche pour le Développement, CP 9214, La Paz, Bolivia*
[b] *Laboratory of Parasitology, Instituto Nacional de Laboratorios de Salud, Ministry of Health and Sport, La Paz, Bolivia*
[c] *IRD UR010, Team 'Mother's and Child's Health in Tropical Environment', Institut de Recherche pour le Développement, Paris, France*

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Summary We evaluated the prevalence of Chagas disease using a rapid screening test (Chagas Stat-Pak), confirmed by ELISA, in Caraparí, a village of 9000 inhabitants in southern Bolivian Chaco. The prevalence of *Trypanosoma cruzi* was estimated in a sample of 995 people. The prevalence adjusted on age was 51.2% and was proportionally related to age. We also observed a very significant cline from the south to the north of the locality, where the prevalence ranged from 40 to 80%. In children younger than 11 years, the prevalence was 21.5%, which confirmed the importance of residual vector transmission despite several years of vector control. Among women of procreation age, the prevalence was 63.9%, resulting in a high risk of congenital transmission. The control of the disease requires an increase in vector control and improvement of dwellings before considering children's treatment with trypanocide.

1. Introduction

Chagas disease is a major parasitic endemic disease in Latin America involving around 9 million people (Schofield et al., 2006). The disease is strongly associated with the poor socio-economic conditions that frequently prevail in these areas (WHO, 1991). However, thanks to vector control, the transmission of Chagas disease is dramatically decreasing in the southern cone of Latin America (Dias, 2007).

In Bolivia, seroprevalence of Chagas disease can reach 90% in adults and is commonly associated with poor, rural dwellings between 300 and 3500 m a.s.l., which represents about 60% of the country and involves around 4 million at-risk people (Carrasco et al., 1990; Noireau, 1999). Vector control of Chagas disease constitutes the first level, and currently the main one, for the control of this endemic disease (Guillén et al., 1997). Its effectiveness changes from one area to another, either for organizational and

* Corresponding author.
E-mail address: chippaux@ird.fr (J.-P. Chippaux)

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logistic reasons, or because of the appearance of vector resistance to insecticides. Secondly, the National Program of Chagas Control (PNCCH) gradually implements throughout the country systematic screening of Chagas disease among pregnant women in order to treat infected newborns. Finally, since 2006 the PNCCH has managed the treatment of all children younger than 15 years with benznidazole when the infestation rate of vectors decreased to less than 3% in the concerned community. This treatment, which is long, expensive and not without risks of severe adverse reactions, is of interest only if there is no risk of vector transmission (PAHO, 1998).

In the municipality of Caraparí, located in a highly endemic area for Chagas disease in southern Bolivian Chaco, the vector control is recent and its effectiveness is variable according to communities. It seems rather insufficient, because, as a whole, the indicator of infestation of the dwellings by the vector *Triatoma infestans* is higher than 8% and in some places reached 40% (PNCCH, not published).

In order to provide arguments for organizing the control of Chagas disease in rural areas, we carried out an epidemiologic survey in this municipality, representative of many others in the Chaco region belonging to Bolivia, Paraguay and Argentina.

2. Materials and methods

Caraparí is located in the Chaco region, department of Tarija, province of Yacuiba, at the border with Argentina. It includes about 60 communities, containing 9000 inhabitants, and has an area of 3000 km^2. There are two first level hospitals, in Caraparí and Itaú, coordinating four and three health centres, respectively. The area of Caraparí is at the foot of the Andes with elevations of 800−1300 m a.s.l. The climate is subtropical, with a great difference from north to south. The northern part of the municipality is dry steppe with grass cover and woody plants, including cacti, whereas the south consists of wet forest.

The study took place between June and September 2007. We carried out a general census of the population, and then we randomized a representative sample of this population to carry out a serologic screening survey.

2.1. Census of the population and randomization of the sample

Two teams of investigators visited all the houses in the municipality of Caraparí and questioned the inhabitants using a standardized questionnaire. The name, age, origin and duration of residence of all the permanent inhabitants of each dwelling were recorded.

The complete and consolidated general census of Caraparí was used to arrange the communities according to their population (Table 1). A number was allotted to each house of the municipality who was charted. We randomized houses using a computer list of random numbers on two level bases, first at community level according to their frequency, then at the habitation level in randomized communities. All people living in selected houses were included in the sample to obtain 1100 people. The list of selected people was drawn up by community and dwelling.

Table 1 Distribution of the study population according to community size

Size of the community (no. families)	No. communities	Proportion of population (%)
≤9	18	5
10−19	20	15
20−39	24	30
40−79	10	25
≥80	5	25

We excluded from the randomization the village of Caraparí (938 inhabitants), which is the capital of the municipality, because of the heterogeneous composition of its population.

2.2. Epidemiological survey

Two teams collected blood samples for the serological screening of Chagas disease. Each one was assigned to a zone of investigation. They informed the population of the date of their passage for the blood sampling. During their visit, they organized an active search for all of the inhabitants of the selected houses. In the event of prolonged or permanent migration of the inhabitants of any selected dwelling, the nearest one on the map was taken. Due to logistical reasons, it was not possible to carry on clinical examination of adults to seek Chagas disease symptoms.

Blood samples were collected from finger, after obtaining signed informed consent. A first immediate diagnosis was performed using an immunochromatographic test, Chagas Stat-Pak (Chembio Diagnostic Systems, Medford, NY, USA), giving a result within 15 min. Meanwhile, a blood sample was collected in 600 μl Microtainer tubes with lithium heparin and plasma separator (Becton Dickinson, Franklin Lakes, NJ, USA). After centrifugation, the Microtainer tube was frozen at −20 °C until a second serological test for confirmation using third generation ELISA (Chagatest, Wiener, Rosario, Argentina). Chagas disease prevalence in the sample of the population was determined using the results of ELISA tests.

2.3. Exhaustive survey in the children younger than 11 years

We also carried out a diagnosis of Chagas disease in all the children younger than 11 years who were not already included in the sample described above. The diagnosis was carried out with the Chagas Stat-Pak test, without ELISA confirmation. In these children, the prevalence was estimated using the result of the Chagas Stat-Pak test.

The results were immediately given to each adult or to the person legally in charge of the minors. Adults were referred to the hospital for clinical surveillance and minors were managed by the rural health network, with the aim of therapeutic management.

2.4. Statistical analysis

Data were entered in Access and calculated with EpiInfo 6 (CDC, Atlanta, GA, USA). Data were adjusted by age on the