Seroprevalence of Trypanosoma cruzi Infection in French Guiana

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A survey was carried out on 1487 individuals to assess the seroprevalence of Trypanosoma cruzi infection in French Guiana. The overall prevalence of T. cruzi specific IgG was 0.5%. In multivariate analysis, residence in areas where housing is favorable for the presence of triatomine bugs was the only factor associated with the presence of T. cruzi antibodies. These results have implications for public health since blood donors are not routinely screened for T. cruzi infection in French Guiana.

Key words: Trypanosoma cruzi - Chagas disease - seroprevalence - French Guiana

Chagas disease (American trypanosomiasis) is caused by the protozoan Trypanosoma cruzi, mainly transmitted to humans by blood-sucking triatomine bugs (Hemiptera, Triatominae) but also transmitted by blood transfusion from infected donors, and occasionally by transplacental mother-to-child transmission. It is estimated that 16-18 million people are infected in Latin America (WHO 1991). However, relatively few cases have been reported from the Guayanas (Guyana, Suriname, and French Guiana) (Luquetti & Schofield 2003).

In French Guiana, only 17 clinical cases of Chagas disease have been reported since 1939 (Floch & Tasque 1940, Beaudet et al. 1985, Esterre & Dedet 1987), including four cases of acute chagasic myocarditis diagnosed between 1994 and 1996 (Carme et al. 2001a). A serological study conducted in 1983-1985, using an indirect immunofluorescence test, showed that only one of 301 individuals (0.3%) had antibodies to T. cruzi (Esterre & Dedet 1987). We present here a cross-sectional study designed to assess the seroprevalence of T. cruzi infection in various areas of French Guiana.

MATERIALS AND METHODS

French Guiana (Figure) is located in the Amazonian forest between Brazil and Suriname. It is technically a Department of France and has the highest living standard in South America. In the 1990 census there were 114,678 inhabitants, and in 1999 were around 157,274 inhabitants. There is massive immigration from neighboring countries which is difficult to quantify, but it is estimated that illegal immigrants represent up to a third of the total population.

For this retrospective study, sera were selected randomly from several large banks of sera from “Centre National de Référence de Virologie et du Paludisme” (Collection Biological samples used for infectious disease surveillance) under the Ministry of Health. These sera are available without need for specific ethical clearance. Sera samples were stored at −80°C, without glycerol, for 3 to 4 years and were thawed once. These samples had originally been collected either for epidemiological studies on human T-cell leukemia/lymphoma virus type I, during routine testing of pregnant women, or during previous studies on viral hepatitis or arboviroses. The samples included most of the ethnic groups and regions of French Guiana. For each sample, basic demographic data included sex, age, place of current residence, and ethnic group (Table I). However, Cayenne and its surroundings was the only region where sera could be selected to include a sufficient number of each ethnic group; thus, the seroprevalence presented in this paper is calculated based on the respective percentages of ethnic groups observed in this city.

Sera were tested with a simple T. cruzi enzyme-linked immunoassay (ELISA) using antigen prepared from trypomastigotes of the Brener CL strain of T. cruzi (Aznar et al. 1997). Briefly, all samples were diluted 1:200 in reference to a previous study (Aznar et al. 1997). Samples were then assayed in duplicate and one negative and one positive control were included on each microplate (Nunc, Roskilde, Denmark). Fifty µl of a 1:1000 dilution of goat peroxidase-conjugated anti-human IgG (Sanofi Diagnostics Pasteur, Paris, France) were added to each microplate (Nunc, Roskilde, Denmark). Fifty µl of a 1:1000 dilution of goat peroxidase-conjugated anti-human IgG (Sanofi Diagnostics Pasteur, Paris, France) were added to each well. After incubation, peroxidase was revealed with 50 µl of a 1/1 mixture of 2,2’-azino-di-3-ethyl-benzothiazoline sulfonate and hydrogen peroxide (ABTS Peroxidase Substrate System, Kirkegaard Perry Laboratories Inc., Gaithersburg, MD). Optical density (OD) was measured at 492 nm for peroxidase activity in an automated ELISA reader (Titertek Multiskan MCC/340 - Lab Systems, France). Sera were considered as positive when the mean of duplicate optical density values reached the mean value obtained from 68 negative controls + 3 standard deviations. Controls were chosen from among blood donors from mainland
France (Aznar et al. 1997). The cut-off value for anti-\emph{T. cruzi} IgG was determined as OD = 0.108.

Data were analyzed using Epi-Info and Egret software. The presence of \emph{T. cruzi}-specific IgG (without specific IgM, data not shown) was considered to denote a chronic infection (Medrano-Mercado et al. 1996). From the results in the different areas of French Guiana, we extrapolated the global seroprevalence using the 1990 national census. Demographic factors related to \emph{T. cruzi} infection were determined by univariate analysis using Chi-square or Fisher’s exact test, with a significance level of 5%. Multivariate analyses using stepwise backward logistic regression were subsequently performed and strength of associations was estimated by the adjusted odd ratios (OR) with 95% confidence interval (CI).

RESULTS

A total of 1487 sera was tested for IgG antibodies to \emph{T. cruzi} (40.3% from men and 59.7% from women, with a median age of 26 years, range 1 to 93). Of these sera, 324 (21.8%) were from patients living in the littoral plain or in Saint-Laurent, originally taken for diagnosis of dengue fever. The remaining 78.2% were taken from pregnant women or during epidemiological studies of populations living in the forest areas of the Oyapock or Maroni River regions.

The seroprevalence rates for \emph{T. cruzi} antibodies ranged from zero to 7.3% according to place of residence, age class, and ethnic group (Tables I, II). Seroprevalence was below 3% except in three areas where the prevalence of antibodies was greater than 6%: in Antécume-Pata in the southern part of the Maroni river (2 of 33 sera, 6.1%), in Cacao in the forest area (3/41, 7.3%), and in Camopi/Trois-Sauts in the southern part of the Oyapock river (6/82, 7.3%). Globally, the seroprevalence of \emph{T. cruzi} antibodies extrapolated for the entire population of French Guiana was 0.5% (95% CI, 0.1-0.8%) (Table I).

Table II shows univariate comparisons of the demographic factors and the context of collection of sera between \emph{T. cruzi} seronegative and seropositive patients. The only factors statistically associated with the presence of anti-\emph{T. cruzi} IgG were residence in Camopi/Trois-Sauts, in Cacao or in Antécume-Pata. The prevalence of \emph{T. cruzi} antibodies did not differ between males and females. Among 321 subjects with fever as the reason for sera collection, the prevalence of \emph{T. cruzi} antibodies was not associated with Dengue fever (data not shown).

After multivariate analysis, the place of residence remained the only factor significantly associated with \emph{T. cruzi} antibodies. The context of collection of sera (sera

<table>
<thead>
<tr>
<th>Table I</th>
<th>Prevalence of IgG antibodies to \emph{Trypanosoma cruzi} according to age class, ethnic group and area of residence, French Guiana, 1992-1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age class (years)</td>
<td>Nr tested</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>102</td>
</tr>
<tr>
<td>10-19</td>
<td>275</td>
</tr>
<tr>
<td>20-29</td>
<td>502</td>
</tr>
<tr>
<td>30-39</td>
<td>304</td>
</tr>
<tr>
<td>&gt; 39</td>
<td>260</td>
</tr>
<tr>
<td>Unknown</td>
<td>44</td>
</tr>
</tbody>
</table>

| Ethnic group | Nr tested | IgG |
| Native American | 416 | 1.7 |
| Brazilian | 160 | 0.0 |
| Caucasian | 62 | 1.6 |
| Chinese | 16 | 0.0 |
| Creole | 120 | 0.0 |
| Haitian | 56 | 0.0 |
| Hmong | 79 | 2.6 |
| Bush-Negro | 440 | 0.7 |
| Others | 34 | 0.0 |
| Unknown | 104 | 0.0 |

| Residence \(^a\) | |
| Littoral plain | |
| Cayenne and surrounding | 170 | 0.0 |
| Macouria/Tomnégrande | 27 | 0.0 |
| Kourou/Sinnamary/Iracoubo | 70 | 0.0 |

| Maroni river region | |
| Awala-Yalimapo | 35 | 0.0 |
| Javouhey/Mama | 36 | 0.0 |
| Saint-Laurent | 34 | 2.9 |
| Apatou | 97 | 0.0 |
| Papaïchton | 183 | 0.5 |
| Maripasoula | 487 | 0.4 |
| Twenké | 30 | 0.0 |
| Antécume-Pata | 33 | 6.1 |

| Oyapock river | |
| Camopi/Trois-Sauts | 82 | 7.3 |
| Saint-Georges | 162 | 0.0 |

| Forest area | |
| Cacao | 41 | 7.3 |

\(^a\): prevalence observed, except for Cayenne where prevalence is calculated taking into account the percentage of ethnic groups in this area.
Table II

Demographic factors and context of collected sera in relation with anti-
Trypanosoma cruzi IgG in French Guiana, 1992-1998: univariate analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Presence</th>
<th>Absence</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.0</td>
<td>0.8</td>
<td>0.66</td>
</tr>
<tr>
<td>Age &gt; 30 years</td>
<td>1.2</td>
<td>0.4</td>
<td>0.11</td>
</tr>
<tr>
<td>Ethnic group a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native Americans</td>
<td>1.7</td>
<td>0.6</td>
<td>0.06</td>
</tr>
<tr>
<td>Caucasians</td>
<td>1.6</td>
<td>0.8</td>
<td>0.43</td>
</tr>
<tr>
<td>Haitians</td>
<td>0.0</td>
<td>0.9</td>
<td>0.60</td>
</tr>
<tr>
<td>Place of residence a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antécume-Pata</td>
<td>6.1</td>
<td>0.8</td>
<td>0.032</td>
</tr>
<tr>
<td>Cacao/Roura</td>
<td>5.1</td>
<td>0.8</td>
<td>0.044</td>
</tr>
<tr>
<td>Camopi/Trois-Sauts</td>
<td>6.2</td>
<td>0.6</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Cayenne and surrounding</td>
<td>0.0</td>
<td>1.0</td>
<td>0.20</td>
</tr>
<tr>
<td>Macouria/Tonnégrande</td>
<td>0.0</td>
<td>0.9</td>
<td>0.79</td>
</tr>
<tr>
<td>Sera collected for fever, year of collection</td>
<td>0.6</td>
<td>0.9</td>
<td>0.43</td>
</tr>
<tr>
<td>Sera collected before 1995</td>
<td>0.8</td>
<td>0.9</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Note: a: anti-T. cruzi IgG were not associated with other ethnic groups and places of residence.

Discussion

Our study suggests that 0.5% of the general population in French Guiana – approximately 785 people – may have T. cruzi specific IgG antibodies. Such a seroprevalence is 1.75 times higher than that previously observed in French Guiana (Esterre & Dedet 1987), and is similar to seroprevalence levels recorded for children in Brazil and Uruguay prior to the Southern Cone Initiative against Chagas disease (WHO 1997, 1998, Schofield & Dias 1999).

By contrast, very few cases of clinical Chagas disease have been observed in French Guiana during the last 50 years (Carme et al 2001b). Several hypotheses could explain this paradox. Firstly, our survey could have overestimated the actual seroprevalence of T. cruzi infection. However, the method that we used, ELISA, offers a high reliability and is concordant with other serological methods such as direct agglutination test or indirect immunofluorescence antibody test (Añez et al. 1999) and PCR (Brenière et al. 2002). Furthermore, T. cruzi trypomastigote extract, with almost no cross-reactivity with other protozoan infections (Aznar et al. 1997), has been shown to be an excellent reagent for detecting the infection in areas of low prevalence, and appears to be better than epimastigote extracts.

Alternatively, it may be that Chagas disease is significantly under-diagnosed in French Guiana, possibly as a result of frequent asymptomatic forms of T. cruzi infection or recent infections with clinical symptoms too mild to be recognized (Medrano-Mercado et al. 1996). Our results could therefore signify the emergence of a public health problem in French Guiana and the number of clinical cases could increase in the future. Indeed, our results indicate highest seroprevalence among people living in rural rain-forest villages (Upper-Maroni, Upper-Oyapock, Cacao) with traditional housing (wood and/or palms). Clinical cases in these areas may well go undiagnosed because of the basic level of health facilities there and because the Hmong and the Native American groups often have different health-seeking behaviors than metropolitan or Creole French ethnic groups. Active detection campaigns should be implemented to establish the true prevalence of Chagas disease in areas of French Guiana with poor medical facilities. Potential vectors such as Rhodnius prolixus and R. robustus are recorded from such areas, and we have also found these species, and Panstrongylus geniculatus, infected with T. cruzi in urban areas of Cayenne and surrounding villages (Aznar C., unpublished observation). These observations lead us to further investigate the presence of infected vectors and domestic or wild reservoirs in rural and urban areas of French Guiana, and also indicate a possible risk of blood transfusional transmission in French Guiana since French law does not require any serological screening of blood donors for this infection.

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Avant la mise à jour de cette version, aucune référence n’a été ajoutée.
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