TRYpanosoma cruzi infections in blood banks of 12 chilean hospitals

Myriam Lorca,2 Antonio Atías,3 Berbeli Astorga,2 Patricia Muñoz,2 and Ivette Carreree2

A survey of Chilean blood banks in areas endemic for Chagas' disease indicates that the risk of transmitting the disease in a blood transfusion ranges from roughly 1 to 7.5 per cent. This finding, consistent with other surveys in Chile, underlines the urgent need to devise a rational policy capable of controlling such transmissions.

Introduction

Trypanosoma cruzi, the agent of Chagas' disease, is highly persistent in blood collected and stored in blood banks (1, 2). Indeed, transfusions constitute the second most important avenue of Chagas' disease transmission in Chile, the most important being provided by the man-biting insect vector Triatoma infestans.

The specific area endemic for Chagas' disease in Chile covers roughly the northern half of the country, extending from latitude 18° South (Region I) in the extreme north, through the metropolitan areas of Santiago and Valparaiso, and down to about latitude 34° South (Region VI). The number of infected persons in this territory has been estimated at 350,000 (3).

An earlier article by the authors (4) reported the presence of blood donors serologically positive for Chagas' disease in two parts of Chile with differing prevalences of infection; and investigators in other Latin American countries—including Brazil, Venezuela, and Argentina—have reported prevalences of infection similar to or higher than those found in our country. Apart from a few isolated efforts, however, no steps have been taken to formulate a policy for Latin America that would help close this avenue of iatrogenic T. cruzi transmission (5). Therefore, in seeking to provide a more thoroughgoing base of information for coping with this problem, we felt it would be appropriate to conduct a serologic survey of T. cruzi infections at diverse blood banks in Chile's endemic area and to assess the risk of infection through blood transfusions in different geographic zones.

Materials and Methods

From 1978 to 1980 a total of 1,332 blood samples were collected at random from individual donors at the time they gave blood in 12 hospitals serving areas with both high and low levels of Chagas' endemicity. Men provided 1,081 of these samples and women provided 251. The donors ranged in age from 18 to 58 years, most of them (85 per cent) being between 20 and 40 years old. Seven of the blood banks were classified as "urban" and five as "rural" on the basis of their hospitals' locations and their donors' areas of residence (Table 1).

The serologic method used to examine the specimens was the indirect immunofluorescent technique described by Camargo (6).
The specificity of this procedure has been established. Highly sensitive, it detects *T. cruzi* antibodies in subjects with early acute cases of Chagas' disease and yields a positive response with 100 per cent of the serum specimens from patients with prolonged infections (it has been demonstrated that the antibodies involved may remain at detectable levels for months and even years—7).

In applying this method, the serum specimens were inactivated at 56°C for 30 minutes, diluted 1:20 in PBS (0.1M, pH 7.2), and applied to an antigen consisting of fixed cultured epimastigotes. The resulting slides were incubated for 45 minutes in a humid chamber, washed twice in phosphate buffer for 10 minutes, and allowed to dry. Subsequently, a drop of human antigammaglobulin labeled with fluorescein isothiocyanate at 1:20 and prepared with Evans blue at a concentration of 1:10,000 was added to each dried slide. The slides were then incubated for 45 minutes at 37°C and were again washed twice in phosphate buffer for 10 minutes. Following this preparation, the slides were read using an incident-light fluorescent microscope, an HbO50 Hg lamp, and BG 12, KP490, and TK 510/K 515 filters.

Results

The results obtained with the tested specimens are shown in Table 2 and Figure 1. Of the 1,332 serologic samples, 80 (6 per cent) yielded positive results, the positive percentages at the various facilities ranging from 2.0 to 14.5 per cent. Averages of the findings for facilities with rural and urban donors in zones of relatively high and low endemicity are shown in Table 3. Overall, 8.3 per cent of the samples from zones deemed highly endemic yielded positive results, as did 4.2 per cent of the specimens from areas of relatively low endemicity. In areas of both high and low endemicity, the areas of high endemicity were

<table>
<thead>
<tr>
<th>Localities</th>
<th>No. of samples</th>
<th>No. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuquicamata</td>
<td>99</td>
<td>10</td>
</tr>
<tr>
<td>La Serena</td>
<td>120</td>
<td>10</td>
</tr>
<tr>
<td>Coquimbo</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>Vícuña</td>
<td>62</td>
<td>9</td>
</tr>
<tr>
<td>Ovalle</td>
<td>215</td>
<td>15</td>
</tr>
<tr>
<td>Valparaíso</td>
<td>148</td>
<td>5</td>
</tr>
<tr>
<td>San Antonio</td>
<td>77</td>
<td>3</td>
</tr>
<tr>
<td>Santiago:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Juan de Dios</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Salvador</td>
<td>112</td>
<td>4</td>
</tr>
<tr>
<td>Universidad Católica</td>
<td>102</td>
<td>4</td>
</tr>
<tr>
<td>Melipilla</td>
<td>104</td>
<td>5</td>
</tr>
<tr>
<td>Rancagua</td>
<td>96</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>1,332</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 2. Percentages of serologic specimens yielding positive results.

*Melipilla is a rural locality in the Santiago area.*
endemicity, the infection was found to be more prevalent among rural people than it was among urban dwellers.

Discussion

Taken together, these prevalence figures of 2 to 14.5 per cent yield an average overall prevalence for endemic parts of the country on the order of 6 per cent. As indicated in a recent review by Pinto Díaz (8), these values are in agreement with those found by similar surveys in other Latin American countries.

The higher prevalence of infection in the blood banks of rural hospitals probably arose from their donors' greater contact with triatomid bugs. (Transmission is easier in rural areas, partly because it is more difficult to carry out successful triatomid control measures in rural areas.) However, residents of large cities are by no means exempt from the risk of transfusion-transmitted Chagas' disease, especially in view of the disease's increasing urbanization in Chile and other parts of Latin America as a result of the steady migration of infected individuals to the cities.

Various investigators have conducted surveys on the prevalence of Chagas' disease in Santiago. As Table 4 indicates, the prevalences found have varied considerably from one survey to another. However, the prevalences of 2, 3.6, and 3.9 per cent found by our survey of three Santiago blood banks appear similar to the results reported by Howard et al. (9) and Schenone et al. (10), while being higher than those obtained by Apt et al. (11). It is possible that the differences in these results obtained at different Santiago blood banks depended to a significant degree on variations in the proportions of donors previously residing in endemic rural areas.

Xenodiagnosis has demonstrated T. cruzi trypomastigotes circulating in the blood of about half the individuals infected with chronic Chagas' disease (12). So it is reason-

Table 3. Average prevalence of specimens yielding positive results at urban and rural localities considered to be of relatively high and low endemicity, within Chile's endemic zone.

<table>
<thead>
<tr>
<th>Origin of specimens</th>
<th>Localities of high endemicity</th>
<th>Localities of low endemicity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of specimens tested</td>
<td>No. positive</td>
</tr>
<tr>
<td>Urban</td>
<td>215</td>
<td>15</td>
</tr>
<tr>
<td>Rural</td>
<td>376</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>591</td>
<td>49</td>
</tr>
</tbody>
</table>

Table 4. Comparison of the results of serologic surveys for Chagas' disease conducted by other investigators and by the authors at various blood banks in the city of Santiago.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year of survey</th>
<th>Hospital surveyed</th>
<th>No. of samples tested</th>
<th>% positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Howard et al. (9)</td>
<td>1962</td>
<td>Luis Calvo Mackenna</td>
<td>311</td>
<td>7.3</td>
</tr>
<tr>
<td>Schenone et al. (10)</td>
<td>1968</td>
<td>José J. Aguirre</td>
<td>305</td>
<td>3</td>
</tr>
<tr>
<td>Lorca et al.</td>
<td>1979</td>
<td>San Juan de Dios</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Apt et al. (11)</td>
<td>1980</td>
<td>Barros Luco-Trudeau</td>
<td>325</td>
<td>0.3</td>
</tr>
<tr>
<td>Lorca et al.</td>
<td>1980</td>
<td>Salvador</td>
<td>112</td>
<td>3.6</td>
</tr>
<tr>
<td>Lorca et al.</td>
<td>1990</td>
<td>Clinica, Universidad Católica</td>
<td>102</td>
<td>3.9</td>
</tr>
</tbody>
</table>
Figure 1. A map of Chile showing the locations of the blood banks surveyed and the percentages of serologic samples testing positively for *T. cruzi* infection.

Figure 1 shows the map of Chile with regions marked for high and low endemicity risk.

Overall, therefore, we should expect that roughly 2.1 per cent of the donors in the area of low endemicity and 4.2 per cent of those in the area of high endemicity would transmit the disease in Chile (Table 5).

Policies for controlling *T. cruzi* contamination of blood bank resources can focus on several approaches: (1) serologic testing of prospective donors and rejection of those found to be infected; (2) addition of a trypanosomicidal agent such as gentian violet or crystal violet (diluted 1:4,000) to the anticoagulant solution; and (3) screening donated blood and treating all seropositive donations with trypanosomicides or suitable physical processes.

The first method (testing prospective donors with highly sensitive serologic techniques and rejecting those found positive) might seem ideal. However, it would incur great expenses—for the required infrastructure, technical equipment, and specialized personnel—and would result in the loss of a considerable volume of usable blood.

The second method (adding a trypanosomicide to the anticoagulant) would permit full use of the blood and would be innocuous to blood recipients (15-18). But it would impart a blue color to the blood, and could therefore provoke rejection of the blood by some recipients.

For these reasons, given the situation that prevails in our country, we feel it appropriate to propose controlling the blood after it has

![Figure 1. A map of Chile showing the locations of the blood banks surveyed and the percentages of serologic samples testing positively for *T. cruzi* infection.](example.png)

Table 5. Approximate risk of *T. cruzi* infection being transmitted in the blood of a given donor to the blood banks surveyed, in areas of “high” and “low” endemicity.

<table>
<thead>
<tr>
<th>Areas of high endemicity %</th>
<th>Areas of low endemicity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of survey samples yielding positive results</td>
<td>8.3</td>
</tr>
<tr>
<td>Approximate risk of infection (%)</td>
<td>4.2</td>
</tr>
</tbody>
</table>
been donated. This should be accomplished by means of a quick and simple diagnostic test that requires no extensive infrastructure and that can be performed in any laboratory. Once identified, blood donations yielding seropositive results would be given appropriate physical or chemical treatment to neutralize the infection, after which they could be used in any way desired.

Regardless of the best course to pursue, however, we believe the accumulated evidence is now sufficient to show iatrogenic transmission of *T. cruzi* through blood transfusions. There is thus an urgent need to chart a rational policy capable of controlling such transmission in our country.

**SUMMARY**

A total of 1,332 serologic specimens from 12 Chilean blood banks in areas endemic for Chagas’ disease were tested by the indirect immunofluorescence method for evidence of *T. cruzi* infection. The endemic area involved, encompassing about half the country, includes the major cities of Valparaíso and Santiago. The results indicated that between 2 and 14.5 per cent of the donors whose blood was tested were infected with *T. cruzi*, the observed prevalences generally being higher at facilities receiving blood principally from rural donors.

Other evidence suggests that roughly 50 per cent of those people with chronic Chagas’ disease have infective trypomastigotes circulating in their blood. Therefore, it seems reasonable to assume that the risk of transmitting *T. cruzi* via a blood transfusion in Chile’s endemic areas ranges from roughly 1 to roughly 7 per cent. There is thus an urgent need to devise a rational policy capable of controlling such transmission in both Chile and other affected parts of the Americas.

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LISTERIOSIS SURVEILLANCE

Between 1 March and 1 September 1981 the largest outbreak of listerio-
sis (seven adult cases and 34 perinatal cases) recorded in North America oc-
curred in Canada’s Maritime provinces. Investigation showed Listeria mo-
noctogenes to be the etiologic agent. The outbreak was unique in that the
source (contaminated coleslaw) was determined by detection of the epi-
demic strain in the implicated food. This identification led to a cabbage
grower who maintained a flock of sheep, two of which were known to have
died of listeriosis in 1979 and 1981. The cabbage was harvested and kept in
cold storage during the winter and early spring, a practice which would
favor the multiplication of L. monocytogenes.

The definitive report of this outbreak was published in the New England
Journal of Medicine, Vol. 308, No. 4, 1983. In addition, a Listeria workshop
was held in Halifax, Nova Scotia, on 1-2 June 1983, and its proceedings
will be published by Canada’s Ministry of Health and Welfare.