Epidemiological and social determinants of Chagas disease and its control in the Amazon countries - Group discussion

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The emergence of Chagas disease transmission in the Amazon region is a new challenge for controlling the disease. It takes on special importance, considering that: (i) vector transmission in homes in many other areas has now been brought under control, or at least that the technology available for control presents proven efficiency; (ii) the transmission patterns are different; (iii) some of its epidemiological and social determinants or risk conditions are unknown.

The enzootic transmission cycle of *Trypanosoma cruzi* has long been known in the Amazon region. Carlos Chagas himself already recognized flagellates isolated from monkeys of the species *Saimiri scirius* as *T. cruzi*, in the year 1924 (Chagas 1924). Following this, many other animal reservoirs were identified (Deane 1961, 1964). The triatomine fauna is also very diversified and natural infection has been observed in several of the species present (Barret 1988, Coura et al. 1994, Schofield 2002).

However, the domestic transmission cycle has not become established in an evident manner or on a large scale. With the progressive human occupation of the region, introduction of non-autochthonous species or colonization by native species as a result of human predatory action on the natural environment were considered likely (Silveira et al. 1984, Barret 1988, Silveira 1997). So far, it has not been possible to confirm this. Nonetheless, autochthonous cases started to be recognized in the Amazon region, including in countries without a history of occurrences of this disease (Shaw 1969, Rambajan 1984, Beauder 1985). Moreover, increasing numbers of such cases have been found over recent years (Valente 2005). On the one hand, this may be ascribed to possible new events or environmental changes. On the other hand, this is certainly due to the greater attention that has been given to studying the disease and performing disease surveillance in this region, even if done non-systematically.

The means of transmission in the Amazon region do not correspond to those that are recognized as characteristic of the endemic disease, with "installation and permanence" of the vector in the home. The known autochthonous cases are produced by the following means of transmission: (i) *oral transmission*, which indirectly or passively may be understood as vectorial, provided that it only occurs by means of contamination of foods by the feces of infected triatomines; (ii) *vectorial transmission in the home, without colonization*, by means of periodic or regular incursions by specimens that invade the home; (iii) *vectorial transmission outside of the home*, by means of frequent human entry into forests and contact with wild triatomines, as occurs with *Rhodnius brethesi* in the case of extraction activities relating to the *piaçaba* palm tree.

The peculiarities of Chagas disease in the Amazon region require the adoption of a surveillance model differing from what has been followed in historically endemic areas, in which it is fundamentally centered on entomological surveillance.

Likewise, in conceptualizing a surveillance and control model for the disease in this region, the following must be considered: (i) the extent of the Amazon territory and the operational difficulties implied; (ii) the fact that it is not recognized as a public health problem in that region; (iii) the resources already installed in the region that mat serve for preventing endemic Chagas disease.

GROUP ACTIVITIES AND DISCUSSION

The group discussion was preceded by a presentation by the reporter on this topic (Marcelo Aguilar), which was developed following a sequence that considered: (i) the delimitation of the Amazon according to different criteria (hydrographic, ecological, and biogeographic); (ii) characterization of the Amazon scenario from the points of world, national and population geopolitics; (iii) land occupation patterns; (iv) structural (environmental) elements of the disease; (v) country-by-country detailing of the existing knowledge about vectors, reservoirs, infection, and the disease in humans.

This presentation was accompanied by a complementary presentation by the president of the session (Antonio C Silveira) covering: (i) matters relating to the "exceptional" means of transmission in the region and the approach towards them, which implies the production of knowledge; (ii) the resources already in place and their possible utilization for surveillance of Chagas disease, as a condition for enabling the proposed actions (primarily and essentially supported by the malaria surveillance system); (iii) the means of institutional integration and organization and shared activities between countries: technical meetings in Palmarí, 2002, and within the Amazon Initiative (AMCHA), 2004 and 2005.

In the discussion on the topic, the participants contributed a variety of data and information on their prac-

tices in the projects and fields in which they are active, and with regard to their knowledge of the situation in the countries that make up the region. These contributions were considered in formulating the conclusions and recommendations presented by the reporter (M Aguilar) at the final plenary session, which are to a large extent included in the report herein presented. The contributions are enumerated according to the specific subject dealt with and the authors:

Transmission by R. brethesi in the Negro river region (Barcelos, state of Amazonas, Brazil) - Dr José Rodrigues Coura gave a report on the situation, starting from the initial investigations and highlighting in particular that: (1) the transmission was basically caused by invasion of the dwellings by the vectors. The dwellings were precarious and temporary, and did not serve as a physical barrier against "visits" by the insects. This differed from some other observations that attributed greater importance to contact with the vector by humans during their *piaçaba* extraction activities (Silveira & Passos 1985); (2) serological diagnosis presents great difficulties, which has meant that the criterion for diagnostic confirmation is that the serum should present three positive reactions; (3) in the most recent studies carried out in the area, infection with the strains Z1 and Z3 of *T. cruzi* was observed; (4) chronic cardiopathy is unquestionably documented in autochthonous cases, which suggests that transmission is not a recent occurrence in the region.

Oral transmission - Dr Roberto Salvatella made the specific proposal that outbreaks of Chagas disease due to oral transmission should be prevented and managed by means of food safety methodology, and that this form of the parasitosis should be considered to be a foodborne disease. For this, it needs to be proposed that studies on outbreaks should be done by means of epidemiological studies on foodborne diseases, with surveys of the critical points and risk analysis on the foods implicated in such transmission, investigation of factors favoring transmission by certain foods (temperature, hygiene, preparation, conservation, and others); development of appropriate domestic technologies for managing and preparing these foods and dissemination of information for prevention, directed towards the population.

Regarding the peculiarities and specificities of vectorial transmission in the region - One comment of a more general nature that was made (Dr Pedro Albajar) was on the great diversity of situations and conditioning factors for the occurrence of the disease in this region. In other words, the Amazon region cannot be treated as a homogeneous ecological-epidemiological area.

Specifically with regard to the knowledge of acute cases among the adult population, Dr Aluízio Prata made the timely remark that, because of the lack of domestic vectors, a longer exposure or contact time between humans and vectors would be needed, since the continuous risk of vectorial transmission that characterizes transmission in places where there is colonization of homes does not exist.

Regarding Chagas disease in the Bolivian Amazon region - Dr Faustino Torrico indicated that Chagas disease in the Bolivian Amazon region is not a priority, because of the extensive endemic area in the remainder of the country, with high levels of transmission in some areas, despite the intensive chemical control actions that are being carried out. This means, however, that little is known about the disease in the Amazon region.

Concerning the importance that *R. stali* might have (sometimes referred to as a potential vector in the Departments of Beni and Pando), he indicated the need to promote more systematized investigations in order to demonstrate its capacity for transmitting *T. cruzi*.

Finally, Dr Torrico mentioned that human occupation of the Amazon region is taking place rapidly and without control. The population has quadrupled over the last decade.

Regarding Chagas disease in the Colombian Amazon region - Dr Felipe Guhl made reference to the presence of *Triatoma maculata* in the Departments of Casanare and Arauca. Furthermore, *R. brethesi* and *R. pictipes* are triatomine species in the Colombian Amazon region that could have some participation in transmitting *T. cruzi* to humans.

On the other hand, he commented that one additional problem in the Colombian Amazon region is drug trafficking, with all its implications for surveillance and control over the disease.

Domestication of T. maculata in the state of Roraima (Brazil) - Dr José Rodrigues Coura and his coworkers gave a report on recent investigations in the city of Boa Vista, capital of the state of Roraima (Brazil), in which high rates of infestation by *T. maculata* were found in homes in the urban area. This veritable "invasion" could be explained by the overpopulation of pigeons in the city. Specimens examined did not show natural infection by *T. cruzi*, which is understandable because of the preferential association of the species with birds. Even so, this massive infestation may represent a future risk, since *T. maculata* is considered to be a secondary vector of importance in some countries, such as in Venezuela.

A final comment from the reporter for the topic, Dr Marcelo Aguilar, was in relation to the need to approach the investigation, surveillance and control of Chagas disease in the Amazon region starting from what he called "hotspots". The territorial extent of the region and the great diversity and complexity that exist would justify this proposal, which is in accordance with what was defined at the Technical Meeting held in Palmarí, 2002, on the strategies to be followed for future actions.

According to what had been agreed at that time, it would be recommendable to integrate entomological, seroprevalence and clinical studies for characterizing the known foci of transmission according to the degree of human impact. The definition given would be *areas (generally concentric) in which the environmental degradation is progressively lower: strongly altered urban/ semiurban center; surrounded by urban areas with a high degree of intervention, which in turn are surrounded by cultivated areas; isolated farms (frequently*

with residues of secondary forest) that are bordered by forested areas that are preserved to a greater or lesser extent. It is considered that this type of focus should be respected, since it will allow fuller understanding of the processes that produce the disease in the region.

CONCLUSIONS AND RECOMMENDATIONS

The *conclusions* from the meeting can be considered in summary to be that:

1. Despite the severe environmental changes that have occurred, generated by the different types of productive occupation of land in the Amazon region, there is insufficient evidence of an imminent risk of domestic colonization by the vectors that maintain a transmission profile in the way that is seen the original endemic areas. So far, just a few situations of incipient domestication have been documented, relating to species like *T. maculata, P. geniculatus, P. herreri, R. neglectus,* and *R. stali*, in restricted areas of Brazil, Bolivia, and Peru.

2. The selective deforestation caused by different types of land occupation in the Amazon region has been associated with areas of transmission of *T. cruzi*, with an accumulated risk that is directly proportional to individuals' ages, which is compatible with an endemic profile for the disease. These situations occur mainly where *R. robustus*, *R. pictipes,* and *R. brethesi* are in contact with the population, without neglecting the importance of other potential vector species. These situations should especially be watched, since they are the ones presenting greatest risk of transmission to human populations.

3. There are sufficient documented observations to have established that endemic transmission exists, although at low levels. However, there have been proven occurrences of severe clinical forms. This situation has been described in Sucumbíos (Ecuador), Guianía (Colombia), Cayenne and Cacao (French Guiana), and the upper and middle Negro river regions of the state of Amazonas (Brazil).

4. These elements characterize a very particular epidemiological profile that requires a differentiated approach. This demands the development of methodologies and techniques suitable for the distinct parasite circulation dynamics of the region.

5. In addition to the particular transmission patterns, the development of new instruments and methods for surveillance and control must take into consideration the existing opportunities represented by the resources already installed, especially the malaria surveillance services that exist in most of the populated areas of the Amazon region, and the operational difficulties caused by the extent of the territory and in many cases by its inaccessibility. In this respect, it cannot be expected that surveillance for Chagas disease in this region will be set up and implemented extensively, because of the fact that it is not recognized as a problem and consequently does not represent a priority.

6. Chagas disease has already been recognized as an emerging problem in several countries, and the scientific community and control organizations have mobilized in search of shared and coordinated action. As a concrete result from these proposals, a first international meeting of a technical nature was held in Palmarí, Brazil, in 2002, at which some guidelines for the investigation, surveillance, and assessment of the control possibilities were established. At this meeting, it was proposed to set up an Intergovernmental Initiative for Surveillance and Prevention of Chagas Disease in the Amazon Region (AMCHA), and PAHO/WHO was designated to be the Technical Secretariat. There were meetings in Manaus (Brazil) in 2004 and in Cayenne (French Guiana) in 2005. At these meetings there was a consensus regarding: (a) an international surveillance network/system adapted to the Amazon subregion; (b) measures for surveillance and prevention of Chagas disease in the Amazon region; (c) proposals for diagnoses and clinical studies regarding Chagas disease in the Amazon region; (d) investigations relating to improvement of epidemiological information, diagnoses, and treatments for the disease.

It was agreed that the strategy for implementing the initiative should have an incremental nature, starting with progressive characterization and demonstration of the risks.

Insofar as the recommendations could be considered applicable to the topic, they were put into sequence according to the guidelines, for group discussion ("Guidelines for Discussion Groups"):

Neglected or emerging matters/Additional knowledge for formulating surveillance and control policies

As already mentioned, it is absolutely necessary to gain new knowledge, thereby seeking to improve the actions proposed for surveillance and control of Chagas disease in the Amazon region.

To set up (or implement) a regular system for surveillance and control of Chagas disease in this region, the services should be instrumentalized to adopt the model that has already been formulated and taken as the consensus by the countries participating in the "AMCHA" initiative, in which the surveillance objectives are: (i) the disease/infection; (ii) the vectors; and (iii) the environment.

These three aspects of the surveillance should be integrated by progressive development of a standardized georeferencing method for acute cases, in relation to the known distribution area for the vectors (or potential vectors) and their preferred ecotope(s). The information generated should be centralized in a database, using a geographic information system that is fed with the data gathered by remote sensing and data obtained by direct collection in the field.

It is evident that, because of the dimensions of the Amazon region, it cannot be expected that comprehensive intervention for surveillance and control of Chagas disease will be established immediately. The initial recommendation is to work on the critical areas already identified as presenting frequent transmission of *T. cruzi* ("hotspots"), at which the epidemiological characteristics of the disease should be studied in depth. Implementation of the proposed actions in these areas will make it possible to validate the recommended technical procedures and actions, with gradual expansion for them.

With regard to the particular situation of family outbreaks of Chagas disease due to oral transmission, it is

recommended, as suggested by Dr Roberto Salavatella, that these should be treated on the basis of food safety methods. In such cases, for the purposes of prevention, it is taken that Chagas disease is a foodborne disease.

Concerning the production of additional knowledge, it is proposed (as already identified at meetings of the AMCHA initiative) that investigation projects should be developed as a matter of priority, taking the following into account (a) categorical proof for the transmission route(s) of the focused outbreaks (micro-epidemics) that have been described, with identification of the risk factors implicated; (b) identification of the ecological, cultural, economic and social factors, and contingencies involved in interactions between humans and triatomines, including seeking to elucidate situations such as the incidence of human infection due to invading vectors that do not colonize the dwelling; the possibility of vectorial transmission outside the home (apart from the transmission already known through *R. brethesi*); and in outbreaks due to oral transmission; (c) studies on the distribution of vector species, starting from characterization of the natural environments and ecotopes in which they have been found, with the aim of predicting their presence in areas with similar ecological-physiographic characteristics; (d) studies on the physical patterns of homes and their vulnerability to invasion or colonization by triatomines, thereby seeking to define the risk that exists; (e) studies on wild triatomines that are recognized as potential vectors, in areas close to or connected with human settlements; (f) specific studies on *R. prolixus* and *R. robustus*, with the aim of greater understanding of their differences and interactions, and their potential for hybridization in nature; (g) the possible influence of chemical control activities against malaria vectors in relation to repelling triatomines; (h) identification of possible clinical peculiarities of Chagas disease in the region.

Capacitation and technology transfer projects

With regard to capacitation needs, it is recommended that the projects implemented should take the following into consideration:

1. Training for laboratory personnel who work on the epidemiological surveillance of malaria, so that they can recognize *T. cruzi*. The most important source of information for identifying acute cases is certainly the data "resulting" from parasitological diagnoses from thick drops of peripheral blood, stained using the Walker/Giemsa method. These tests, which are carried out extensively for malaria surveillance and so far have been allowing sporadic or "random" detection of *T. cruzi*, should be used routinely for Chagas disease surveillance in this region.

Examination of fresh peripheral blood offers practical advantages and may be faster and more sensitive, with regard to viewing the parasite in movement, especially considering that cases with low levels of parasitemia are common. Nonetheless, from the perspective of carrying out wide-ranging surveillance action on Chagas disease, together with malaria surveillance, there would not be any procedure other than what is routinely adopted for diagnosing malaria.

When autochthonous acute cases of Chagas disease are identified, it may be recommendable that, over the course of the investigations, fresh blood tests are performed on contacts related to the case.

2. Strengthening of the capacities for clinical and laboratory diagnosis, thereby determining the significance of the cross-correlated results and defining a protocol for serological diagnosis.

How to achieve capacitation and technology transfer

To capacitate the laboratory personnel, it is proposed that, where there is regular training for technicians working within malaria surveillance (which is considered to be the practice within malaria programs), a week on *T. cruzi* identification should be inserted into the course program.

In addition to *T. cruzi* investigation, it is considered recommendable to include information on epidemiology and biosafety in the program content. The target public would be technicians involved in diagnosing malaria (of high school or university level).

In other situations in which there is no possibility of integrating such material in malaria courses, areas considered to be a priority will have to be selected for promoting capacitation. These will be based on histories, occurrences of autochthonous cases, seroprevalence data that may be available, and the opportunities and facilities that may exist.

For clinical and auxiliary medical personnel, it is suggested that courses directed towards the areas of greatest risk should be promoted, with identification of services that could act as reference centers for Chagas disease patient care, and whose trained professionals would serve as multipliers for extending the knowledge to primary healthcare services.

Implementation of the dissemination of information

Considering the limited existing knowledge and its fragmentation, it is fundamental that a supranational body be created, to bring together and regularly disseminate the information generated.

In this respect, the Internet program that ALCUE Health proposes to create may take on a role of prime importance in surveillance and control for Chagas disease in the Amazon region, as an instrument to be used regularly by the AMCHA initiative.

Availability of the information necessary and its sufficiency

As already mentioned several times, Chagas disease in the Amazon region is an emerging public health problem that follows transmission patterns that are largely unknown. The knowledge accumulations are restricted to certain areas and episodic events, although tending towards some continuity, which may mean that endemic Chagas disease is becoming permanently established in the region. The operating models for surveillance and control that have so far been formulated and incompletely developed must be refined and possibly redefined as the determining conditions for the occurrence of Chagas disease in the Amazon region become known.