CHAGAS' DISEASE IN EL SALVADOR[1, 2]

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Epidemiologic studies of Chagas' disease in El Salvador have indicated the extent of Trypanosoma cruzi *transmission in various areas studied and the disease's probable public health importance. Manifestations of both the acute and chronic phases of the disease appear milder than in most South American countries.*

Introduction

Trypanosoma cruzi infection patterns vary in different parts of the Americas. In some countries the extent of infection has been determined, while in others it is unknown.

In 1961 Romaña (*1*) divided the countries of Middle and South America into three groups on the basis of what was known about infection patterns at the time. Group I consisted of countries with national programs against Chagas' disease (Venezuela, Brazil, Uruguay, Chile, and Argentina); Group II included countries where there was substantial information about the disease (Guatemala, Panama, Ecuador, and Peru); and Group III was composed of countries and territories where the true importance of Chagas' disease was unknown (Mexico, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, Colombia, Guyana, Surinam, French Guiana, Bolivia, and Paraguay).

Despite El Salvador's inclusion in the latter group, there was in fact considerable information about the disease in that country. The first known human case of trypanosomiasis caused by *T. cruzi* in El Salvador was reported by Segovia en 1913 (*2*). Since then a number of reports have supplied data on the prevalence of the disease in various parts of the country (*3-13*). These provide a basis for the present review, which describes the major epidemiologic and pathologic features of Chagas' disease in El Salvador for purposes of consolidating available information and pointing out some matters in need of more extensive study in the future.

Epidemiologic Characteristics

House Infestation by Trypanosome Vectors

A 1957 survey of 137 Salvadorean communities found 26.3 per cent of 1,102 houses examined to be infested by two triatomid bugs that serve as trypanosome vectors. As subsequent surveys have shown, this triatomid infestation rate can reach 100 per cent in small rural settlements where the local type of dwelling favors proliferation of the bugs (see Table 1). However, it is important to note that high infestation rates can occur even in semi-urban areas, respective rates of 28.0 per cent and 86.7 per cent having been found in the small cities of Armenia and Cojutepeque (*12, 13*).

On the basis of information now available, it is believed that the vector *Triatoma dimidiata* predominates within thatch and adobe dwellings of regions 600 meters or more above sea level, while *Rhodnius prolixus* is common in dwellings of straw or thatch below 300 meters.

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TABLE 1–Percentage of triatomid-infested houses in various Salvadorean communities.

Collection area, year, and source of data	Urban or rural	Elevation (meters)	No. of houses examined	Infested houses	
				No.	%
General Survey:					
137 communities, 1957 (*9*)	U and R	Varied	1,102	290	26.3
Partial Surveys:					
Capulín and San Diego (Municipality of Metapán, Santa Ana Department), 1958 (*10*)	R	475	110	105	95.5
San Diego (Municipality of Metapán Santa Ana Department), 1964 (*11*)	R	650	40	35	87.5
Municipalities of San Isidro and Cinquera (Cabañas Department), 1964	R	400	14	14	100.0
San Jerónimo (Municipality of Guazapa, San Salvador Department), 1965*	R	400	12	12	100.0
Armenia (Sonsonate Department), 1967 (*12*)*	U	350	60	52	86.7
Cojutepeque (Cuscatlán Department), 1967 (*13*)*	U	800	50	14	28.0

*Results of statistical sample surveys.

At intermediate elevations both vector species have been found.

T. cruzi *Infection of Vector Species*

Table 2 shows the rates at which *T. cruzi* was observed to infect these two species in a number of Salvadorean communities. In all, 6,411 adults and nymphs were examined and 1,623 (25.3 per cent) were found infected. Combining data for the two species, observed infection rates ranged from 15.2 per cent in Casa de Piedra, a small predominantly rural settlement 12 km outside San Salvador, to 48.8 per cent in the vicinity of Armenia (*12*). It can be seen that both bug species frequently harbor the parasite, though the observed rate of infection in *T. dimidiata* (30 per cent) was notably higher than in *R. prolixus* (23 per cent). The high rates of triatomid infection found in two semi-urban areas surveyed (Armenia and Cojutepeque) was probably due to certain rural features in these areas (especially the types of dwellings used and sociocultural practices of the inhabitants).

Another noteworthy point is that past surveys have found a significant proportion of *R. prolixus* specimens (5.6 per cent) infected by the trypanosome *T. rangeli,* which is not known to be pathogenic in man (see Table 3). This epidemiologic data deserves careful future study, especially since *T. rangeli* was identified primarily by direct microscopic examination of each insect's intestinal contents, stain seldom being used. This means that *T. rangeli* may be more common than previously reported in rural areas, especially where *R. prolixus* predominates. When the bug specimens' intestinal contents were stained after initial examination in the San Jerónimo survey, for example, a higher infection rate (11.4 per cent) was found. It is thus felt that precise identification of *T. rangeli* in future studies could help pave the way for determining the true nationwide prevalence of *T. cruzi*. In the past, combined *T. cruzi* and *T. rangeli* infections were reported in only 28 (0.8 per cent) of the 3,400 *R. prolixus* examined.

TABLE 2–Rates of *T. cruzi* infection among triatomid bugs collected at various Salvadorean localities.

Collection area, year, and source of data	*T. dimidiata*			*R. prolixus*			Total (both species)		
	No. of bugs examined	No. positive	% positive	No. of bugs examined	No. positive	% positive	No. examined	No. positive	% positive
General Survey:									
137 communities, 1957 (*9*)	1,767	533	30.2	2,068	282	13.6	3,835	815	21.3
Partial Surveys:									
Capulín and San Diego (Municipality of Metapán, Santa Ana Department), 1958 (*10*)	2	0	0.0	260	40	15.4	262	40	15.3
San Diego (Municipality of Metapán, Santa Ana Department), 1964 (*11*)	0	–	–	472	114	24.2	472	114	24.2
Municipalities of San Isidro and Cinquera (Cabañas Department), 1964	1	0	0.0	1,312	446	34.0	1,313	446	34.0
San Jerónimo (Municipality of Guazapa, San Salvador Department), 1965*	16	4	25.0	70	29	41 4	86	33	38.4
Casa de Piedra (vicinity of Los Planes de Renderos, San Salvador Department),1965	112	17	15.2	0	–	–	112	17	15.2
Armenia (Sonsonate Department), 1967 (*12*)*	38	23	60.5	257	121	47.1	295	144	46.0
Cojutepeque (Cuscatlán Department), 1967 (*13*)*	36	14	38.9	0	–	–	36	14	38.9
Totals	1,972	591	30.0	4,439	1,032	23.2	6,411	1,623	25.3

*Results of statistical sample surveys.

Animal Reservoirs

There has been little study of *T. cruzi* prevalence in wild and domestic animals of El Salvador (*9*). The parasite was reported in one dog out of 68 tested by examination of thick blood films. Also, a trypanosome morphologically similar to *T. cruzi* was found in three out of 111 bats tested by direct examination of blood specimens (the bats were of the genera *Artibeus, Chylonicteris,* and *Desmodus*). Examination for *T. cruzi* has yielded negative results in all other animals tested–including 12 cats (*Felis domesticus*), 20 armadillos (*Dasypus novemcinctus*), 6 murine opossums (*Didelphis murina*), 2 agoutis (*Dasyprocta punctata*), and 21 rats and mice (*Rattus* spp., *Mus* spp.).

TABLE 3–Rate of *T. rangeli* infection among triatomid bugs collected in various Salvadorean localities.

Collection area, year, and source of data	*T. dimidiata*			*R. prolixus*		
	No. of bugs examined	No. positive	% positive	No. of bugs examined	No. positive	% positive
General survey:						
137 communities, 1957 (*9*) .	1,767	24	1.4	2,068	109	5.3
Partial surveys:						
Municipalities of San Isidro and Cinquera (Cabañas Department), 1964	1	0	0.0	1,312	76	5.8
San Jerónimo (San Salvador Department), 1965	16	0	0.0	70	8	11.4
Totals	1,784	24	1.3	3,450	193	5.6

TABLE 4–Results of complement fixation tests for *T. cruzi*, conducted with human sera from residents of various Salvadorean communities.

Sera collection area, year, and source of data	Urban dwellers			Rural dwellers		
	No. of sera tested	No. positive	% positive	No. of sera tested	No. positive	% positive
Cities of San Salvador and Santa Ana, 1957 (*9*) (hospitalized patients)	343	23	6.7	342	59	17.3
Capulín and San Diego (Santa Ana Department), 1958 (*10*)	0	–	–	145	35	24.1
San Diego (Santa Ana Department), 1964 (*11*)	0	–	–	182	85	46.7
Armenia (Sonsonate Department), 1967 (*12*)*	278	25	9.0	0	–	–
Cojutepeque (Cuscatlán Department), 1967 (*13*)*	199	27	13.6	0	–	–
San Jerónimo (San Salvador Department), 1972*	0	–	–	100	33	33.0

*Results of statistical sample surveys.

Infection in Humans

The highest percentages of serologically positive reactions to *T. cruzi* have been found in adults and children from rural parts of the country (see Table 4). However, it should be pointed out that the complement fixation (CF) tests used to obtain these results were not entirely uniform. Until 1958 an aqueous extract of cultured *T. cruzi* was used for antigen, and reactions yielding hemolysis inhibition of 50 per cent or more were considered positive. Since then serologic tests have been conducted using the CF technique described by Freitas and Almeida (*14*).

The percentages of positive reactions obtained in some communities were consistent with those typically found in areas highly endemic for Chagas' disease. For example, the 1964 survey conducted in the rural area of San Diego, Metapán, found that sera from 85 out of 182 persons examined (46.7 per cent) gave a positive CF reaction for *T. cruzi*. The rate of positive reactions was higher among adults (67.8 per cent) than among persons under age 15 (27.4 per cent). The difference between these rates is statistically significant. However, xenodiagnosis[4] yielded results that were the reverse of these; that is, it revealed parasitemia in 55.5 per cent of those under age 15 who had given a positive or uncertain CF reaction, as opposed to only 15.9 per cent of those over that age (*11*). This high degree of serologic response in the rural child population suggests a high prevalence of *T. cruzi* in the areas studied.

Equally significant results have been reported from serologic surveys using Salvadorean blood banks. Of 1,000 blood donors tested at San Salvador's Rosales Hospital in 1963, 5.3 per cent yielded a positive CF response (*15*); and in 1970, hemagglutination testing of sera from 537 donors at the Maternity Hospital in San Salvador yielded an 8.7 per cent positive response (*16*). These results suggest that blood transfusions could act as a vehicle for *T. cruzi* transmission in El Salvador, but more detailed research will be needed to confirm this impression. In any event, the findings demonstrate a need to carry out routine serologic examinations to investigate the presence of *T. cruzi* infections in blood donors.

[4]Diagnosis based on feeding uninfected triatomid bugs on the patient and finding the parasite in the bugs' feces several weeks later.

TABLE 5–Results of *T. cruzi* xenodiagnosis of adults and children from various Salvadorean communities.

Test area, year of test, and source of data	Urban dwellers			Rural dwellers		
	No. examined	No. positive	% positive	No. examined	No. positive	% positive
San Salvador and Santa Ana, 1957 (*9*) (hospitalized patients)	65	15	23.1	374	69	18.4
Capulín and San Diego (Santa Ana Department), 1958 (*10*)	0	–	–	132	5	3.8
San Jerónimo (San Salvador Department), 1972*	0	–	–	100	17	17.0
Schoolchildren of various communities, 1972 (*17*)*	305	7	2.3	226	14	6.2

*Results of statistical sample surveys.

Parasitology surveys based on xenodiagnosis have indicated a higher percentage of persons with *T. cruzi* among rural dwellers than in the urban population (Table 5). The roughly equivalent results obtained from hospitalized patients in rural and urban areas are presumably explained by the fact that most patients seeking hospital care in El Salvador come from rural areas. Recent xenodiagnosis of schoolchildren between 6 and 15 years of age, selected at random from various Salvadorean communities (*17*), showed average rates of infection of 2.3 per cent in urban areas and 6.2 per cent in rural communities.

While these isolated statistics indicate that *T. cruzi* transmission in the country is probably important, there is no reliable morbidity data because notification of the disease is not compulsory. An average of 147 cases per year was reported in 1963-1967, and 232 cases (8.6 per 100,000 inhabitants) were reported in 1968. As Table 6 shows, the latter figure is similar to

TABLE 6–Reported cases of Chagas' disease in the Americas, by country, 1963-1968.

Country	1963-1967 (Average No. of cases)	1967 (No. of cases)	1968	
			No. of cases	Cases per 100,000 inhabitants
Argentina	2,239	3,443	2,726[d]	11.5
Bolivia	–	–	12	0.6
El Salvador[a]	147	148	232	8.6
Guatemala	305	489	–	–
Honduras[a]	...	...	28	1.7
Panama	4	3	1	0.1
Paraguay[a]	17	17	96	8.3
Peru[b]	2	12	7[d]	0.1
United States[c]	–	–	1	0.0
Uruguay	2	–	1	0.0
Venezuela[a]	423	461	538	8.0

Source: Pan American Health Organization, *Reported Cases of Notifiable Diseases in the Americas, 1968*, Washington, D.C., 1971 (Scientific Publication 223).

[a]Reporting area, 1967 and 1968.

[b]Reporting area, 1967.

[c]Chagas' disease is not a notifiable disease in the United States.

[d]Provisional data.

– Data not available.

... Quantity zero.

annual incidences reported in Argentina, Honduras, Paraguay, and Venezuela (*18*). However, the rate in El Salvador is doubtless much higher than that, since the reported cases were discovered only by chance—in the course of routine examination of thick-film blood preparations to detect malaria parasites at the laboratory of the National Campaign Against Malaria (CNAP). (In 1970 the laboratory reported 127 slides positive for *T. cruzi* out of 572,373 examined.) As is generally recognized, examination of thick-film preparations is not an adequate procedure for revealing the presence of *T. cruzi* in the blood.

Data are virtually nonexistent with regard to nationwide mortality from *T. cruzi* infections. Four deaths were reported in El Salvador during 1968, as compared to 12 in Panama, 17 in Chile, and 406 in Venezuela (*18*).

Pathological Characteristics

The foregoing epidemiologic information suggests that *T. cruzi* infection may be a real public health problem in El Salvador. But though both acute and chronic cases of Chagas' disease have been reported with some frequency, the parasite's importance as a disease agent has not been fully evaluated. Fever and the ophthalmoglandular syndrome (Romaña's sign) have been the principal symptoms reported in children and young adults with acute Chagas' disease. A predominant share of electrocardiogram (ECG) changes, consisting of first-degree atrioventricular block and flattening or inversion of the T-wave, as well as cardiomegaly to a lesser degree, have been reported in children (*9*). It is clear that these cardiac changes have appeared less frequently and have seemed less severe than those commonly observed in other countries. In Brazil, for example, although the severity of acute Chagas' disease varies, 50 per cent of the cases show ECG alterations (*20*).

In El Salvador, cardiac insufficiency was the predominant symptom observed in 20 of 31 patients with parasitologically and serologically confirmed cases of chronic Chagasic myocarditis (*9*). The ECG changes most frequently seen in those cases were: ventricular extrasystoles (70 per cent), right-branch block (45 per cent), auricular fibrillation (22 per cent), and atrioventricular block (16 per cent). On the other hand, clinical and laboratory study of another group of 33 patients with positive CF tests failed to reveal any ECG changes or symptoms characteristic of the chronic phase of the disease (*9*).

Regarding observed pathological changes, a review has been made of 4,999 autopsies performed at the Rosales Hospital (San Salvador) from 1945 to 1966 (*21*). Acute Chagas' disease was the reported cause of death in only one case, that of a 48-day-old infant who entered the hospital with fever and convulsions. Nor were any parasites found in the tissues of 268 patients with myocarditis, despite the fact that 45 of these cases were classed as chronic myocarditis, with 12 of the 45 yielding serologic reactions and showing ECG changes suggestive of *T. cruzi* infection. It should be mentioned, however, that these pathological studies were not directed specifically at finding the parasite.

The impression exists, therefore, that the severity of *T. cruzi* infection is only moderate in El Salvador, and that the parasite does not cause significant myocardial damage there, as it does in some South American countries; but in fact there have been no longitudinal studies devoted to finding out what proportion of those infected develop the chronic phase of the disease.

Even though the sum total of available information has established the potential importance of *T. cruzi* infection in El Salvador, there is insufficient data at present to assess the various factors that determine the epidemiology of the disease. Aspects about which little is known and which merit further study include the following: The true prevalence of *T. cruzi* and *T. rangeli*, especially in rural areas; the transmission indices for both parasites; the severity and evolution of heart damage in persons infected with *T. cruzi*; the presence or absence of visceral damage, particularly megacolon and megaesophagus; the importance of domestic and wild animal reservoirs; and the importance of *T. cruzi* transmission through blood transfusions.

SUMMARY

Several studies on Chagas' disease in El Salvador have supplied important epidemiologic information, including the following: (1) Rates of house infestation by triatomid vectors have ranged from 26.3 per cent to 100 per cent in various localities studied, higher rates being found in rural than in urban areas. (2) *Triatoma dimidiata* and *Rhodnius prolixus* are the two vectors of *T. cruzi* in El Salvador, with *T. dimidiata* predominating in localities at elevations above 600 meters and *R. prolixus* in those below 300 meters. (3) *T. cruzi* infection rates in these triatomids have ranged from 15.3 to 48.8 per cent, the average being 25.3 per cent. The average rate found for *T. rangeli* infection of these triatomids was 5.6 per cent. (4) *T. cruzi* infection in humans has been more prevalent among rural dwellers than among urban inhabitants. Xenodiagnosis positivity rates have ranged between 3.8 and 18.4 per cent of the individuals examined. Positive reactions to the complement fixation test have ranged from 17.3 to 46.7 per cent. (5) The acute phase of the disease has been observed in both children and young adults. Nevertheless, ECG and radiologic changes appear to be less common and milder than those reported in South American countries. (6) Further studies are required in order to better define the status of Chagas' disease in El Salvador.

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