

The Sylvatic Cycle of *Trypanosoma cruzi*: a Still Unsolved Puzzle

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Despite its clonal structure (Miles & Cibulskis 1986, Tibayrenc & Ayala 1986) *Trypanosoma cruzi* presents an extreme variability and the seminal studies described the pleomorphism of this tripanosomatid. The slender blood forms have been taken for immature forms or male gametes and the large blood forms, as mature forms or female gametes (Chagas 1909, Brumpt 1912). Since then, all attempts made to correlate biological, biochemical and morphological parameters of the parasite with the course of the experimental infection or with the different aspects of Chagas disease, has led to controversial results. Nevertheless, the study of enzyme electrophoresis profiles defined three major subpopulations (zymodemes) in Brazil, associated to domestic (ZII) or sylvatic transmission cycle (ZI and ZIII) (Barrett et al. 1980). More recently molecular markers separated two distinct and major phylogenetically lineages in *T. cruzi* also associated to the domiciliar transmission cycle (lineage 1), and to the sylvatic transmission cycle (lineage 2) (Souto et al. 1995, Zingales et al. 1997, Fernandes et al. 1998).

However, what is the so-called "*T. cruzi* sylvatic transmission cycle"? It is well known that naturally infected mammals and bugs can be found in almost any sylvatic ecotope, but very little is known about the kinetics of the transmission of *T. cruzi* among its vertebrate and invertebrate hosts in the natural environment. The performed surveys reflect a cross sectional analysis of the enzooty, and do not consider the peculiarities of the interaction of the parasite with a given host. The studies of the interaction of *T. cruzi* with marsupials, considered to be the most important and probably the most ancient reservoirs, has yielded

a series of new data on the biology and ecology of this flagellate. This is exemplified by the cycle undertaken by the parasite in the lumen of the scent glands of *Didelphis marsupialis*, where the protozoan multiplies as epimastigotes and differentiates into metacyclic forms (Deane et al. 1984). The extracellular multiplication cycle of *T. cruzi* in the scent glands of the opossum *D. marsupialis* evidences that, besides being a reservoir host, this species can also be a vector of *T. cruzi*. Another peculiarity of the interaction of *T. cruzi* with marsupials, is the effective control of the infection by *D. marsupialis* and *Philander opossum*. Moreover, *D. marsupialis* are able to rapidly control and even eliminate infections with *T. cruzi* Y strain, while maintaining other strains indefinitely without any significant tissue lesion (Deane et al. 1984). *P. opossum*, on the contrary, maintains both types of strains (Pinho et al. 1993).

Studying the circulation of *T. cruzi* among triatomine vectors, *P. opossum* and *D. marsupialis* captured in a same area of the Atlantic Coastal Rainforest we observed that 50% of the marsupials and bugs, were naturally infected. The biological, biochemical and molecular characterization of the *T. cruzi* isolates defined two groups, associated mainly to *P. opossum* or *D. marsupialis*. The collected bugs (*Rhodnius prolixus*) were most probably involved with the transmission of the parasite among *D. marsupialis*, since their *T. cruzi* isolates displayed similar biological, biochemical and molecular characteristics. Furthermore although *P. opossum* and *D. marsupialis* occupy the same sylvan habitat exclusively *D. marsupialis* frequents and even colonize human dwellings and therefore was considered as a link between the sylvan and domestic transmission cycles but it was observed that only *P. opossum* harbored *T. cruzi* lineage 1 parasites. The presence of lineage 1 in *D. marsupialis* is rare (Zingales et al. 1998, Fernandes et al. 1999). These findings and our previous observations that in experimental conditions *P. opossum* do not select subpopulations of

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T. cruzi, contrary to *D. marsupialis*, strongly suggested two independent transmission cycles occurring between these two marsupial species that live sympatrically. Furthermore suggest an explanation to the absence of human infection in the studied area.

Going further in our observations we decided to study, in another area of the Atlantic Coastal Rainforest, a greater range of hosts: sloths, rodents, marsupials and golden lion tamarins (*Leontopithecus rosalia*), an endangered primate species included in a conservation program. There, we observed a completely distinct enzootic picture since *L. rosalia* was the most infected species, (52%) in comparison to the marsupials (5.3%) and rodents (18%). All *L. rosalia* isolates were typed as belonging to lineage 1. On the other hand, all isolates derived from the other mammals including one sloth isolate, were typed as belonging to lineage 2. The only bug found in that area, a *Triatoma vitticeps*, was infected with flagellates which were in lineage 1 (Lisboa et al. 1996). Our observations suggest that dispersion of *T. cruzi* in the sylvatic environment can occur through simultaneous distinct and independent transmission cycles which are ruled by still unknown factors, not including e.g. forest strata, since golden lion tamarins and sloths are both arboreal animals. Moreover, the sylvatic transmission cycle is much more complex than assumed up to now. Therefore, no generalization or prediction should be made in an enzootic study of parasites and each ecotope should be considered as a unique system by every program which include managing of the sylvatic environment. Several pathogenic trypanosomatids of mammals infect a broad range of vertebrate and invertebrate hosts circulating therefore among dozens of different species of insects and mammals in distinct ecotopes. Consequently, the outbreaks of the diseases are driven by diverse factors such as the presence of carriers, wildlife reservoirs, concentration of infected animals and vectors, husbandry practices which are strongly affected by the environmental conditions and should be taken into account.

Among trypanosomatids, *T. cruzi* has one of the broadest mammal host ranges, being able to parasitize the most varied tissues, thereby colonizing almost every niche available. This versatility ensures that many unorthodox niches such as the opossum scent glands and cartilage (Deane et al. 1984, Lagrange et al. 1992). This aspect, together with the capability of maintaining distinct transmission cycles between sympatric hosts, gives an

undoubted advantage to this eclectic parasite characterizing *T. cruzi* as one of the most successful organisms to adopt the parasitic way of life.

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