Control of Schistosomiasis in Brazil: Perspectives and Proposals

José Rodrigues Coura

Departamento de Medicina Tropical, Instituto Oswaldo Cruz, Av. Brasil 4365, 21045-900 Rio de Janeiro, RJ, Brasil

Attemps to control schistosomiasis have hitherto involved the use of one or more of the following methods, either in isolation or in combination: (1) control of the intermediate host using molluscicides or biological methods; (2) basic sanitation and clean water supply; (3) health education; (4) individual or mass treatment; (5) protection of individuals in such a way as to prevent cercariae from penetrating the skin; (6) vaccine-based strategies against schistosomiasis.

None of these methods is capable, on its own, of bringing about effective control of schistosomiasis, except in populations of a very limited size or under very special conditions. Molluscicides, besides expensive and toxic, have only a temporary effect. As for biological control, there is no effective method yet. Basic sanitation and clean water supply combined with health education potentially constitute the most effective approach, but only in the mid-to-long term. Mass treatment reduces morbidity, but does not control transmission. Protection of individuals has proved to be impraticable on a large scale. Vaccine-based strategies against schistosomiasis are still in the experimental stage.

Experiments carried out in Brazil in the last 20 years have shown that mass treatment with single doses of oxamniquine or praziquantel can rapidly reduce levels of Shistosoma mansoni *infection and morbidity in endemic areas. They have also shown that subsequent transmission and reinfection frequently occur in defined foci or "clusters", due to human contact with water, and in inverse proportion to the number and frequency of treatments carried out. On the basis of these experiments, the author suggests a multidisciplinary strategy for schistosomiasis control.*

Key words: schistosomiasis control - multidisciplinary strategy

The control of schistomiasis is one of the most difficult tasks facing public health services in affected countries, owing to the world-wide spread of the intermediate host, its escape mechanisms in relation to existing control methods, the frequency of human contact with water, the dynamics of schistosomes transmission, the lack of sanitation and clean water supply for human populations and the limitations of individual and mass treatment/protection. Furthermore, the control of schistosomiasis using combined measures is very expensive and, to be effective, has to be maintained over the mid-to-long term. Protection of individuals in such way as to prevent cercariae from penetrating the skin will not be discussed in this paper, nor will vaccine-based strategies, because these methods are still in the very early experimental stages.

CONTROL OF THE INTERMEDIATE HOST

The observations made by Paraense et al. (1954) and Paraense (1955) 40 years ago concerning both re-invasion of breeding places by snails and the processes of self-and cross-fertilization in *Biomphalaria glabrata* led the identification of an important escape mechanism for these snails. The authors reported that many snails routinely buried themselves in the mud of their breeding sites up to a depth of 40 cm, and concluded that such snails remained unaffected by molluscicide treatment. Buried snails were found alive, and few days later were observed depositing self-fertilized eggs. It was discovered that within 90 days a single specimen of *B. glabrata*, under favorable conditions in terms of food and temperature, could produce 10 million individuals over three generations (Paraense 1987).

In addition, Sullivan et al. (1984) demonstrated tolerance of some strains of *B. glabrata* to niclosamida and copper sulfate. Thus, these snails have shown to have at least two escape mechanisms against molluscicides. Fig.1 shows how many people and material are needed for a single molluscide campaign in a very restricted area. As well as being very expensive, a major desvantage of this method is that molluscicides require repeated application and have a number of environmental side-effects.

The biological control of schistosoma vectors with microbial agents, parasites, predators and competitors has sometimes given satisfactory results in the laboratory, but has failed to deliver decisive gains in the field. The most effective

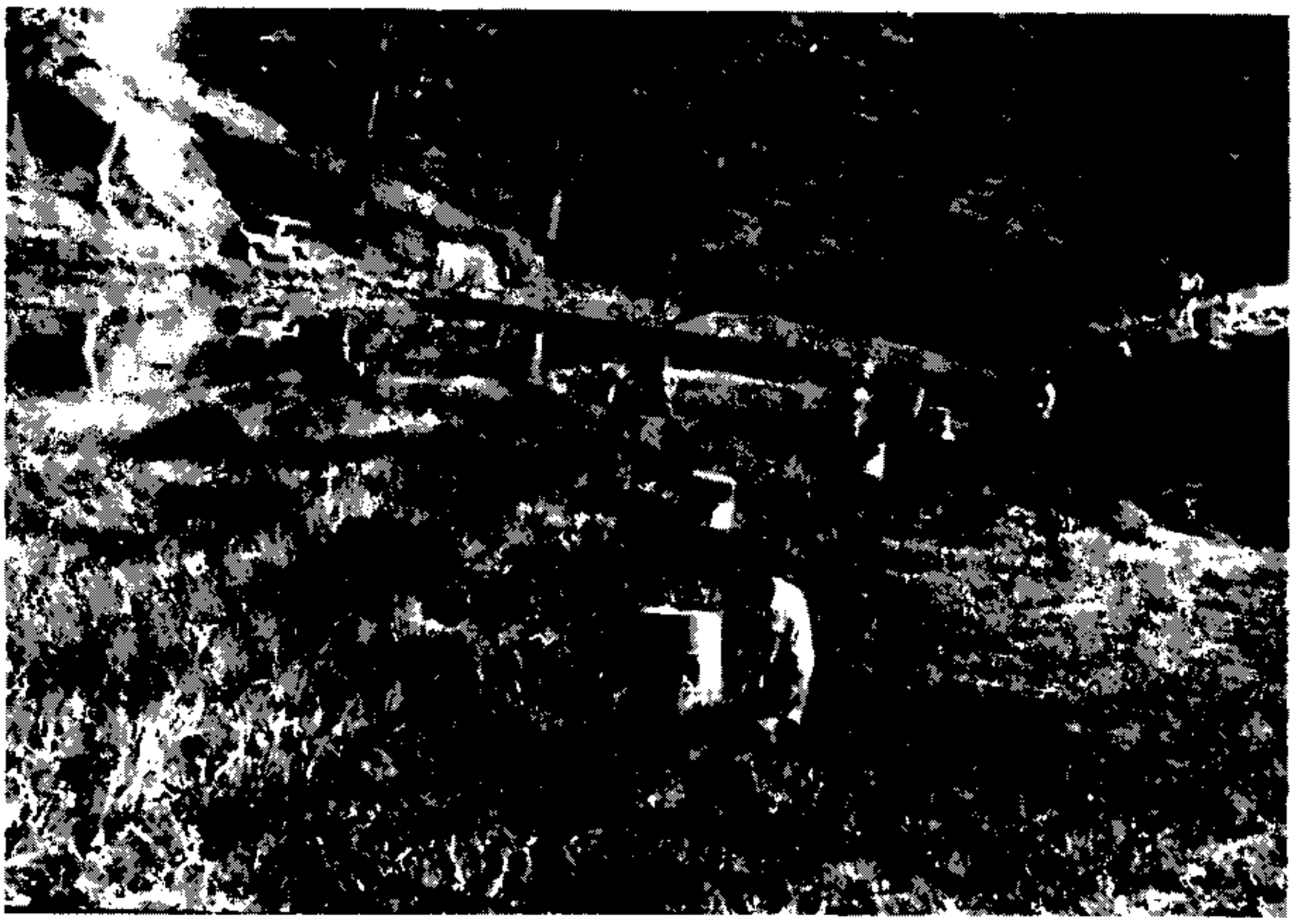

Fig. 1: application of niclosamida in a small endemic area. Note the number of persons and quantity of material involved.

biological agent against *Schistosoma mansoni* is *Ribeiroia marini*, described by Marin (1928) as Cercaria IV and redescribed by Faust and Hoffman (1934) under the name of *Cercaria marini*. It destroys the ovotestis of parasitized biomphalarias (Harry 1965), causing castration. Golvan et al. (1974) and Golvan (1978) observed natural *R. marini* infection in 90% of *B. glabrata* during the dry season in the island of Guadeloup, with a complete disapearance of the snails in some parts of the island. Combes et al. (1975) showed that the common rats *Rattus rattus* and *Rattus norvergicus* are the definitive host of *C. marini* in Guadeloupe, a finding confirmed by Nassi (1978). The latter carried out a field control study of *B. glabrata* involving dayly applications of laboratory rats faeces in specific foci (Nassi et al. 1979). Despite a significant decline in population, however, the snails reappeared in the following rainy season.

Several competitors and predators, such as *Pomacea lineata, Marisa cornuarietis, Helisoma duryi, Tilapia*, etc., have been used in pilot snail control studies, sometimes leading to an inicially drastic reduction of population, but with disappointing final results (Paraense 1987).

BASIC SANITATION AND CLEAN WATER SUPPLY IN COMBINATION WITH HEALTH EDUCATION

Basic sanitation and clean water supply combined with health education potentially constitute the most effective approach to schistosomiasis control, but only in the mid-to-long-term. The classic solution involving only basic sanitation and clean water supply would, in theory, be the most effective method, but it is very difficult and expensive to achieve such a solution in large endemic area, like in Brazil, that covers 1,000.000 km^2. This is a dream to come true in the next century.

More simple methods of water supply and sanitation can reduce the prevalence and morbidity of schistosomiasis, but only in the long term and if associated with permanent health education programs. According to Pitchford (1958, 1972), in some parts of Africa where water was supplied for domestic purposes and other simple and relatively cheap measures were encouraged in order to reduce human contact with water, schistosomiasis infection rates were also declining progressively. In northeasthern Brazil, Barbosa et al. (1971, 1992) showed that schistosomiasis could be effectively controled with relatively limited intervention involving community-organized sanitation programs. The case of Saint Lucia, reported by Jordan et al. (1975), is very impressive because it shows that, with simple introduction of household water, a significant reduction in human contact with water can be achieved leading to reduce schistosomiasis prevalence and incidence.

Finally, effective and permanent control of schistosomiasis will only be possible with changes in human behavior through health education, with the improvement of the basic social and economic standards of the involved communities and with enforcement by public health services, as occured in Japan, Puerto Rico and Venezuela.

INDIVIDUAL AND MASS TREATMENT

Studies carried out in some endemic areas in Brazil have shown that specific chemotherapy for schistosomiasis, delivered either to individuals or in mass treatment campaigns, reduces the severity of the disease's clinical forms, and also that mass treatment can temporarily reduce the prevalence of infection (Kloetzel 1963, Bina 1977, Santos 1978, Katz et al. 1978, 1980). However, because of frequent re-infections in endemic areas, mass treatment, even when repeated several times, cannot completely control schistosomiasis (Katz et al. 1978, 1980, Coura et al. 1980, 1987, Prata et al. 1980, Santos & Coura 1986, Cutrim 1987, Cutrim & Coura 1992, Coura et al. 1992). As we can see in Figs 2, 3 from Coura et al. (1980, 1987), after the first mass treatment with oxamniquine there is a sudden drop in the prevalence of infection and in the egg load, but this is followed by rapid re-infection and egg load reconstitution, and even after five mass treatment an important residual infection remains. This problem occurred on a large scale in the Brazilian Special Program for the Control of Schistosomiasis, financed by the Ministry of health from 1976 onwards.

MULTIDISCIPLINARY STRATEGY FOR SCHISTOSOMIASIS CONTROL: A PROPOSAL

On the basis of our field experience of schistosomiasis control in Brazil in the last 20 years, we propose the following tentative schedule for the short, mid and long term (Table).

The Table can be summarized as follows: (1) in the short-to-mid term: mass treatment when prevalence is > 30% of the population, and selective treatment when $\leq$ 30%, together with use of

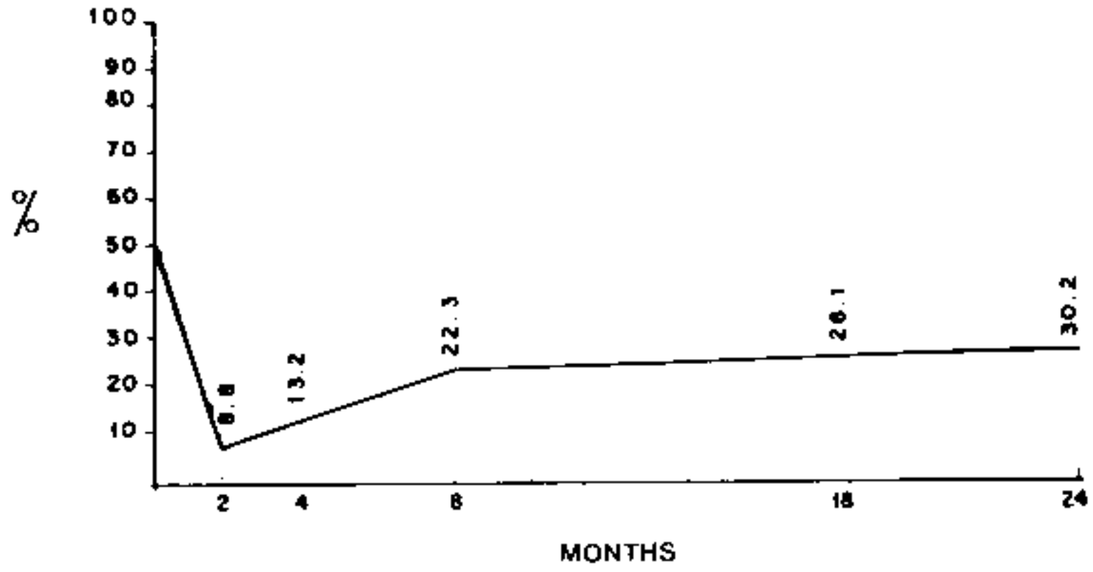

Fig. 2: attempt to control schistosomiasis by mass treatment with oxamniquine. Note the initial drop in the prevalence and the rate of re-infection in 24 months.

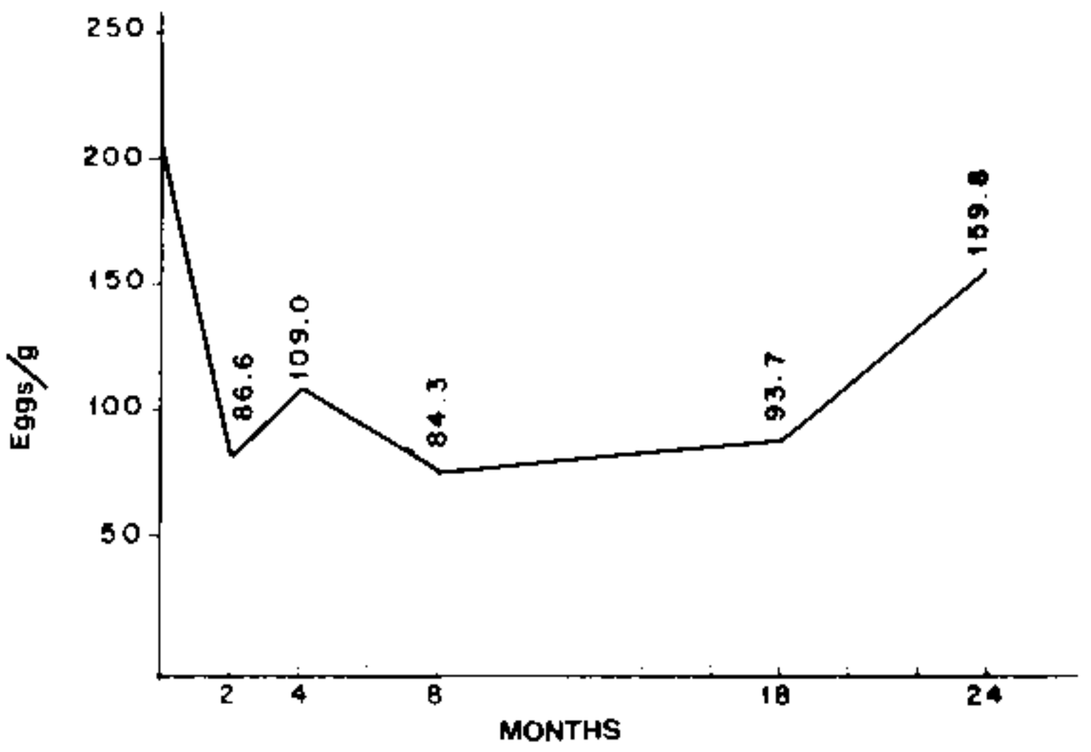

Fig. 3: egg load reconstitution 24 months after mass treatment with oxamniquine.

TABLE

Schedule for schistosomiasis control in short, mid and long term

Measures	Time (years)												
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	20th	30th	Nth
Short/mid term													
Prevalence > 30%													
•Mass treatment	x	x	x		x					x			
•Mollucicides (Dry season)	x	x	x		x					x			
•Surveillance	x	x	x		x					x			
Prevalence ≤30%													
•Selective treatment	x	x	x		x					x			
•Molluscicides (Dry season)	x	x	x		x					x			
•Surveillance	x	x-	x		x					x			
Mid/long term													
•Water supply	x-	x	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-
•Basic sanitation	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-
•Health Education	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-	x-
•Surveillance	x	x	x		x					x	x	x	x

molluscicides in transmission foci, during the dry season, in the 1st, 2nd, 3rd, 5th and 10th years; (2) in the mid-to-long term: water supply, sanitation and health education; (3) evaluation at the end of the 1st, 2nd, 3rd, 5th and 10th years; (4) follow-up for two more decades.

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