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# Use of praziquantel for clinical treatment and morbidity control of schistosomiasis japonica in China: a review of 30 years' experience

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**Abstract**

Chemotherapy is widely acknowledged as the most important, rapid and cost-effective method of reducing morbidity due to schistosome infections. The discovery of praziquantel in the 1970s has been a breakthrough for treatment of patients infected with schistosomes, including *Schistosoma japonicum* in China, and entire communities at risk of schistosomiasis. Praziquantel is usually administered in a single oral dose and has no or only mild and transient side effects. The drug is highly efficacious against *S. japonicum*, both in patients with acute and chronic stages of the infection, among subjects with extensive hepatosplenic involvement, and in patients with other complicated diseases. The cost of praziquantel has been reduced significantly over the past years. Hence, praziquantel has become the backbone of the national schistosomiasis control programme in China and in other countries where the disease remains endemic, most notably in sub-Saharan Africa. Chemotherapy with praziquantel also plays a role in transmission control of schistosomiasis, although transmission interruption cannot be reached by chemotherapy alone. Here, I review 30 years' of experiences gained with the use of praziquantel for clinical treatment and larger-scale control of schistosomiasis japonica in China.


*Keywords:* Schistosomiasis; *Schistosoma japonicum*; Chemotherapy; Morbidity control; Praziquantel; Treatment; China

## 1. Introduction

In the mid 1980s, there was a conceptual shift in the global strategy of schistosomiasis control from transmission control to morbidity control (WHO, 1985). This shift was greatly facilitated through the advent of praziquantel, a safe and orally-active antischistosomal drug with a broad spectrum of activity (Gönnert and Andrews, 1977; Groll, 1984). The first clinical trials with praziquantel against *Schistosoma japonicum* were carried out in the late 1970s in the Philippines (Santos et al., 1979) and in China (Yang et al., 1981). The results of these trials confirmed the high efficacy this drug also exhibits against the other four human schistosome parasites, namely *S. haematobium* (Davis et al., 1979), *S. mansoni* (Katz et al., 1979), *S. intercalatum* (Feldmeier et al., 1981) and *S. mekongi* (Nash et al., 1982).

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In the meantime, millions of people have been treated with praziquantel in different ecological, epidemiological and socio-cultural settings, and hence morbidity due to schistosomiasis has been greatly reduced (Chen, 1999; WHO, 2002; Fenwick et al., 2003; Richter, 2003; Utzinger and Keiser, 2004).

Here, I review 30 years' of experiences with the use of praziquantel in China. In the next section, emphasis is placed on all aspects of clinical use of praziquantel at the individual patient level. In Section 3, the large-scale employment of the drug for the national schistosomiasis control programme is reviewed. In a companion piece, published also in this special issue of Acta Tropica, my colleague Xiao Shu-Hua reviews the Chinese contributions with regard to antischistosomal drug discovery over the past 30 years (Xiao, 2005).

## 2. Clinical use of praziquantel

### 2.1. Dosage schedules

In China, praziquantel is now mainly administered as single oral dose of 40–50 mg/kg body weight. A total dose of 60 mg/kg, divided into three or six split-doses given 4–6 h apart in 1 or 2 days, is also used, particularly in hospital settings or among patients who are severely ill. The current recommendations are supported by a number of different dosage schedules that have been tested in China, ranging from a single dose of 30 mg/kg to a total dose of 120 mg/kg administered over 4–6 days, as shown in Table 1 (Fu and Chen, 1990).

For cerebral schistosomiasis, Chinese clinicians prefer to use a higher dosage, i.e. a total of 90 mg/kg administered over 3 days or a total of 120 mg/kg given over 4–6 days, to ascertain higher therapeutic efficacy (Chen et al., 1981).

Table 1
Different dosage schedules of praziquantel tested in the treatment of *S. japonica* in China

| Total dose of praziquantel (mg/kg) | Dosage schedule | Patients treated |
|---|---|---|
| 30 | Single dose | Chronic cases |
| 40 | Single dose | Universal treatment |
| 40 | Single dose | Chronic cases |
| 45 | Divided doses | Chronic cases |
| 50 | Single dose or two split doses administered on the same day | Chronic cases |
| 60 | Two–six doses administered over 1–2 days | Chronic cases |
| 90 | Split doses administered over 2–3 days | Chronic cases |
| 90 | Split doses administered over 6 days | Advanced cases |
| 120 | Split doses administered over 4–6 days | Acute cases |

### 2.2. Effect of praziquantel-based chemotherapy

In one of the first clinical trials with praziquantel against *S. japonicum*, 199 infected patients, as determined by positive miracidium hatching tests, were treated with 60 mg/kg praziquantel, divided into six doses administered over 2 days. These patients were examined daily by the hatching technique to study the change of miracidia in patients' faeces. All participants eventually became negative between 9 and 19 days after the initial dose of praziquantel (Yang et al., 1981).

Follow-up results by three consecutive hatching tests 3 and 6 months post-treatment with different dosage schedules are shown in Table 2. High efficacies were found in areas where transmission of *S. japonica* was controlled or interrupted. In endemic areas where the intermediate host snail, i.e. *Oncomelania hupensis*, occurred abundantly, and active transmission was documented, parasitological cure rates 3–6 months after treatment were comparatively low, namely 50–80%.

On the basis of studies comparing four different treatment regimens of 30, 40, 50 and 60 mg/kg, praziquantel at a total dose of 40 mg/kg is recommended for clinical treatment and mass chemotherapy, i.e. those with histories of contact with infested water. Results of double-blind, randomised, placebo-controlled trials, carried out in *S. japonicum* endemic areas that established this evidence-base, are shown in Tables 3 and 4 (Chen et al., 1985). A higher dosage (90 mg/kg) over 2 days, although resulting in a cure rate of 100%, seems unnecessary due to its relatively higher side effects and increased costs. However, in acute cases of *S. japonicum*, often associated with heavy infection intensities,

Table 2
Results of post-treatment stool examination in *S. japonica* patients in areas with low transmission

| Praziquantel regimes (days; total dose, mg/kg) | Period post-treatment (months) | No. of persons | | Reduction (%) |
|---|---|---|---|---|
| | | Examined | Egg-negative | |
| 1; 40 | 3 | 86 | 78 | 90.7 |
| 1; 45 | 3 | 39 | 38 | 97.4 |
| 1; 45 | 6 | 41 | 40 | 97.6 |
| 1; 50 | 3 | 131 | 131 | 100 |
| 1; 60 | 3 | 147 | 146 | 99.3 |
| 1; 60 | 6 | 187 | 183 | 97.9 |
| 2; 60 | 3 | 682 | 677 | 99.3 |
| 2; 60 | 6 | 787 | 776 | 98.6 |
| 2; 90 | 3 | 85 | 85 | 100 |
| 2; 90 | 6 | 84 | 84 | 100 |
| 3; 72 | 3 | 128 | 127 | 99.2 |
| 6; 90[a] | 3 | 16 | 16 | 100 |
| 6; 90[a] | 6 | 21 | 21 | 100 |
| 6; 120 | 6 | 36 | 35 | 97.2 |

[a] *Note*: for schistosomal liver fibrosis and/or with co-existent serious illness.

Chinese clinicians prefer to use the dosage schedule of 120 mg/kg over 6 days. This schedule is supported by data comparing different regimes, such as a total of 60–70 mg/kg over 2 days or a total of 90 mg/kg over 3 days (Chen, 1996).

Table 3
Results of parasitological follow-up 6 months after praziquantel treatment in *S. japonicum*-endemic areas

| Group | Total dose (mg/kg) | No. treated | No. examined | No. negative | % |
|---|---|---|---|---|---|
| A | 2 × 30 | 100 | 99 | 79 | 79.8 |
| B | 2 × 25 | 101 | 99 | 71 | 71.7 |
| C | 2 × 20 | 100 | 99 | 78 | 78.8 |
| D | 2 × 15 | 99 | 97 | 68 | 70.1 |

Table 4
Results of parasitological follow-up with regard to chance of reinfection with *S. japonicum*

| Group[a] | Areas without reinfection No. negative/no. examined (%) | Areas with reinfection No. negative/no. examined (%) |
|---|---|---|
| A | 49/55 (89.1) | 30/44 (68.2) |
| B | 51/56 (91.1) | 20/43 (46.5) |
| C | 48/54 (88.9) | 30/45 (66.7) |
| D | 45/55 (81.8) | 23/45 (54.8) |

[a] Note: the dosage schedules of groups A, B, C and D here were the same as shown in Table 3.

### 2.3. Clinical improvement

Treatment of *S. japonicum*-infected individuals with praziquantel causes a dramatic decrease in, or cessation of, schistosome egg excretion. As a result, symptoms caused by the schistosome infection, which is to a large extent due to the parasite eggs trapped in the tissues, quickly abate.

#### 2.3.1. Acute cases

Generally, 3–5 days after the initial praziquantel therapy (in the absence of antipyretics or corticosteroids) subsidence of fever was noted in association with a marked improvement in general condition. Body temperature fell to normal within an average of 10 days (Chen et al., 1981).

#### 2.3.2. Chronic cases

Heavily infected individuals or symptomatic patients in the chronic phase showed a favourable response after treatment with praziquantel, as symptoms disappeared, children's body weight increased, and their recognition ability, as well as adult's working capacity improved (Chen and Mott, 1988; Nokes et al., 1999; Ezeamama et al., 2005).

#### 2.3.3. Advanced cases with hepatosplenic disease

Regression of liver and spleen size has been reported following praziquantel treatment. During a 4-year

follow-up study done among 287 cases in a cohort drawn from Jiaxing county, Zhejiang province, transmission was virtually interrupted following treatment campaigns. Prior to treatment, 110 (38.3%) participants had a palpable liver below the right costal margin, 193 (67.2%) had a palpable liver more than 2 cm below the xiphoid process, and 96 (33.4%) had splenomegaly. Physical examination 4 years later revealed hepatomegaly under the right costal margin in 35 people (a 68% decrease), and more than 2 cm below the xiphoid in 78 people (a 60% decrease), and splenomegaly in 19 people (an 80% decrease) (Fu and Chen, 1990).

#### 2.3.4. Cerebral schistosomiasis

Compared to *S. haematobium* and *S. mansoni*, infection with *S. japonicum* more often leads to cerebral schistosomiasis (Fu and Chen, 1990; Davis, 2003). There was a tendency that praziquantel was more effective than other antischistosomal drugs, i.e. niridazole, amoscanate and potassium antimony tartrate, in reducing seizure activity. After total doses of 90 mg/kg over 3 days or 120 mg/kg over 6 days, most of the seizures were reduced in frequency and finally disappeared. Praziquantel administered in combination with symptomatic treatment for reducing intracranial pressure resulted in the decrease and eventual disappearance of symptoms caused by intracranial hypertension, e.g. headache and vomiting (Fu and Chen, 1990).

#### 2.3.5. Schistosomal dwarfism

This type of patients may benefit from treatment with praziquantel at a high dose, i.e. 70 mg/kg as three divided doses given on a single day. In these patients, chemotherapy followed by hormone treatment may accelerate growth and sexual development, especially for those below 20 years of age (Fu and Chen, 1990).

#### 2.3.6. Improvement in laboratory findings

Peripheral blood pictures, hepatic function tests and immunological functions improved significantly after treatment with praziquantel, especially in acute schistosomiasis japonica and symptomatic chronic patients (Chen et al., 1983b; Fu and Chen, 1990). Hepatic fibrosis in the hepatosplenic disease may improve following chemotherapy in some cases. In some patients, fibrosis is too advanced, and hence does not resolve following treatment with praziquantel (Chen, 1996). Similar observations have been reported for *S. mansoni* (Richter, 2000) and *S. mekongi* (Biays et al., 1999).

### 2.4. Epidemiological impact

Population-based mass chemotherapy in areas with high transmission has shown great benefits in terms of a decrease in the prevalence and intensity of *S. japonicum* infections, associated morbidity and even transmission. An important epidemiological feature of *S. japonicum* is that bovines and other domestic animals serve as reservoir hosts (Mao, 1987). Hence, praziquantel treatment of bovines is an important strategy for schistosomiasis control in China. A synchronous chemotherapy both of humans and bovines was carried out in several villages in Jiangxi province for four consecutive years. An 88.3% reduction in prevalence among residents was observed, and morbidity due to the disease also significantly decreased (Lin et al., 1996).

### 2.5. Side effects and toxicity

During the initial period of clinical trials of praziquantel against *S. japonicum*, careful monitoring of its side effects was done among several thousands of hospital patients in different settings. The predominant dosing schedule of praziquantel to patients enrolled in these trials was 60 mg/kg in three–six divided doses during 1–2 days. Virtually all trials have confirmed the absence of toxic effects of praziquantel on vital organs. Over the past 27 years, with the experience of large-scale administration of praziquantel in China with more than 50 million people infected with *S. japonicum* or living in areas at high risk receiving the drug, the following adverse effects were observed: gastrointestinal disturbance, headache, dizziness, insomnia, fatigue, myalgia, transient skin eruption or pruritus, and premature beats with otherwise normal electrocardiograms. Deterioration of hepatic functions, such as elevation of alanine aminotransferase, increase of serum bilirubin or even appearance of jaundice and increase of ascites, was only seen in very few patients with damaged liver functions (Fu and Chen, 1990).

While any of these symptoms may be encountered after administration of praziquantel, it must be stressed that adverse effects are mild and transient; they usually disappear within 24 h. The excellent safety profile of praziquantel is underscored by the huge number

of people who received treatment within the frame of the national schistosomiasis control programme, often implemented under challenging operational conditions. A retrospective survey of side effects due to praziquantel was made in the early 1980s among 25,693 cases infected with *S. japonicum* and treated 1–2 years earlier (Chen et al., 1983a). Supported by findings during the field survey, and agreed upon by all medical workers, praziquantel is an excellent antischistosomal drug based on its ease of administration, high therapeutic efficacy and low toxicity. To date, no single death directly related to praziquantel-based chemotherapy for the control of schistosomiasis japonica has been recorded in China. Thus praziquantel is widely appreciated for the treatment of infected individuals in the community, and enables mass chemotherapy for those at high risk of infection, irrespective of their infection status. However, care is needed when praziquantel is administered to patients with chronic disease, such as heart failure, neuropsychiatric diseases, ascites, poor hepatic compensation and renal failure, as well as cerebral cysticercosis (Chen et al., 1983a).

### *2.6. Early treatment with praziquantel for the prevention of acute schistosomiasis*

Rescue workers in China, many of whom have no acquired immunity to schistosome infection, take part in flood fighting, and hence they are at considerable risk of becoming infected with *S. japonicum*. Praziquantel lacks efficacy against the young developmental stages of schistosomes and exhibits highest efficacy against the adult worms (Xiao et al., 1987). However, treatment should be given as soon as possible, otherwise the mature worms lay eggs in the host's body, causing pathological effects. In consideration of this knowledge-base, Chinese scientists have effectively used praziquantel for early treatment to prevent acute schistosomiasis. For example, in the summer of 1995, high-level floods in the Yangtze River around Nanjing city persisted for 20 days. Rescue workers who fought the floods were in contact with the water for up to 2 weeks. Large areas of their body surface were exposed to the water. The flooded areas were known to be at high risk of *S. japonicum* transmission as the infection rate in the intermediate host snail was high. Praziquantel, at a single dose of 40 mg/kg, was provided to individuals 5 weeks after their initial water contacts. Overall, 48,668 out of 50,320 rescue workers (96.7%) were given praziquantel. At a 6-month follow-up, none of the praziquantel-treated flood relief workers had a history of suffering from acute schistosomiasis. During the floods, boat dwellers accompanying a team of transportation boats passing through the areas were invited to take part in fighting the floods for 1 week. When the floods ceased, the boat dwellers left Nanjing for home where schistosomiasis is not endemic and therefore they missed early treatment with praziquantel. After 1–2 months, 45 out of 60 boatmen (75%) manifested Katayama fever syndromes and were diagnosed with acute schistosomiasis (Wang et al., 1998). These observations provided strong evidence for the prophylactic effect of praziquantel against acute schistosomiasis japonica. Subsequently, praziquantel has been endorsed by health workers for early treatment of flood relief workers in *S. japonicum*-endemic areas during the transmission season.

## 3. Chemotherapy strategy in China's national schistosomiasis control programme

### *3.1. Role of chemotherapy between the 1950s and 1980s*

In the early phase of China's national schistosomiasis control programme, the endemic situation was serious (Chen, 1999; Zhou et al., 2005). Chemotherapy is life saving. However, the antischistosomal drugs available at the time, mainly trivalent antimonials, were quite toxic. A number of people died due to the toxic effects of the drugs. For example, the Adams–Stokes syndrome, caused by ventricular fibrillation, and toxic hepatitis, have been documented due to the administration of potassium antimony tratrate (Fu and Chen, 1990).

Later, several chemicals were synthesized and used clinically, e.g. sodium antimony gallate for oral use, sodium antimony dimercaptosuccinate for intramuscular use, and non-antimonials, such as amoscanate, furapromide, niridazole and hexachloroparaxylol (Xiao, 2005). However, the safety profile of these compounds is sub-optimal and relatively long treatment courses are required. Hence, none of these drugs matched the requirements for their large-scale use. Individual treatment based on confirmed diagnosis

(either by finding of miracidia or eggs in the stool) had been the main approach for the national schistosomiasis control programme between the mid 1950s and the mid 1980s. When compared with the large scale use of praziquantel over the past two decades, chemotherapy before played a comparatively limited role in the national schistosomiasis control programme.

### 3.2. Praziquantel-based chemotherapy

Large-scale production and use of praziquantel have revolutionized chemotherapy, and hence morbidity control of schistosomiasis. As the drug is safe, exhibits a broad spectrum of activity, and is highly efficacious when administered as a single oral dose, other antischistosomal drugs were replaced by it and faded out. Since the mid 1980s, along with a significant cost reduction, praziquantel has become the drug of choice for morbidity control due to schistosomiasis (Chen, 1999; WHO, 2002; Cioli and Pica-Mattoccia, 2003). In China, praziquantel is also widely used for cattle treatment. In this regard, the documented death of more than 100 heads of praziquantel-treated animals has to be noted. This is explained by the difference in the anatomy and physiology of the gastrointestinal tract in cattle when compared to humans. So currently some veterinary workers still prefer to use amoscanate for treatment, as this compound is less toxic to cattle, is inexpensive and has a good efficacy.

With the advent of praziquantel, the global strategy to control schistosomiasis has changed (WHO, 1985, 1993). This change also occurred in China. From the mid 1950s until the mid 1980s, emphasis was on transmission control targeting the intermediate host snail, primarily by means of environmental management. This strategy was complemented with chemotherapy, health education, water supply and sanitation. By 1995, Fujian, Guangdong, Guangxi, Shanghai, and Zhejiang provinces (municipality, autonomous region) reached the criteria of elimination, greatly aided by economic development in the coastal areas. However, in parts of the lake and mountainous regions, where large areas are infested with *O. hupensis*, schistosomiasis control and elimination proved particularly challenging. In the face of slower economic development, the former strategy is unlikely to meet the ambitious goal of transmission control or even interruption and disease elimination. In line with morbidity control advocated by WHO (WHO, 1985, 1993), chemotherapy with praziquantel has become the mainstay of China's national schistosomiasis control programme.

As praziquantel-based chemotherapy has become the cornerstone for schistosomiasis control, the issue arose how to implement this strategy most effectively. Both scientists and control workers in China have explored different chemotherapeutic approaches, and hence experiences have been accumulated over the past 20 years through large-scale practice.

Several useful approaches for community-based treatment have been developed according to suggestions put forth by WHO (WHO, 1993), in concert with China's epidemiological situation and practice. The three main approaches are as follows:

- *Mass treatment*: treatment of the entire population aged between 5 and 65 years without preliminary screening.
- *Selective treatment*: treatment of infected persons identified by a diagnostic survey (either faecal examination or serological tests) among the whole population.
- *Phased treatment*: use of the above strategies in a sequence of progressively greater selectivity.

The criteria for mass treatment have been changed over time in response to the achievements made through the central interventions, and they are readily adapted to the local settings. For instance, during the 10-year World Bank Loan Project for schistosomiasis control in China, implemented from 1992–2001, praziquantel was provided to the whole population aged between 5 and 65 years, in areas with a prevalence of *S. japonicum* $\geq$15%. After 2–3 years, this strategy was modified. Praziquantel was then only administered to those with a history of infested water contact. Those who never came into contact with infested water were excluded from mass treatment. From 2002 onwards, the strategy of mass treatment was further modified to include all inhabitants in areas with prevalence $\geq$20% in a sample population. As a result, the size of mass treatment has been reduced. For people who frequently contact infested water, and who live in areas where cattle and water buffaloes are farmed on marshlands with infected snails present, praziquantel treatment has been carried out by local health workers twice a year.

In areas with medium endemicity, i.e. *S. japonicum* prevalence between 3% and 15% in a population sample, selective treatment was provided based on positive results either employing a serological test or faecal examination. As the schistosomiasis control programme has been carried out for many years, intensity of infection among infected persons has gradually decreased (at present infection intensities are usually <40 eggs per gram of stool (EPG)). Faecal examination, although serving as gold standard for the diagnosis of *S. japonicum*, shows an unsatisfactory sensitivity when infection intensities are low. As a result, the number of infected people is considerably underestimated. Serological tests that are based on the detection of specific antibodies or antigens have been used widely during the past two decades (WHO, 2002). Selective treatment may be based on those with one or more positive serological tests. As a whole, serological tests may overestimate the number of truly infected persons owing to the following reasons: (i) false positive reactions may occur, (ii) cross reactions with other trematode infections and, more importantly, and (iii) during intensive control programmes a large number of persons are treated once or even several times. In individuals with a history of antischistosomal treatment, serological tests can produce positive results after elimination of the infection. In view of praziquantel's excellent safety profile and its low cost, health authorities and local residents accept that a proportion of uninfected individuals are treated. In fact, depending on the overall endemicity of the disease, this approach is more cost-effective than parasitological diagnosis prior to treatment.

In areas with low endemicity, i.e. *S. japonicum* prevalence <3%, case screening was limited. Only those who had a history of water contact with known transmission sites, those who felt sick or family members of infected persons were screened by faecal examination or serological tests. Treatment was then administered to those found positive in either examination. Bovines pastured in high transmission areas (e.g. marshlands) outside the village were often treated without prior screening.

In highly endemic areas, after two or three rounds of mass chemotherapy, a significant decrease in both prevalence and intensity of infection might be reached. The frequency of chemotherapy is reduced accordingly, from once a year to once every other year; or chemotherapy is selectively given to those infected, based on screening results.

### *3.3. Synchronous chemotherapy of humans and bovines*

In China, synchronous chemotherapy given to humans and bovines has been used widely. This strategy is supported by epidemiological data and mathematical modelling; domestic animals such as cattle, water buffaloes, pigs, goats, sheep, and some wild animals, mainly rats, are of greater importance than humans in terms of contamination of the environment with their eggs and hence transmission of the disease (Mao, 1987; Williams et al., 2002). Animal reservoirs have been a big problem in the schistosomiasis control work in China. Among them, cattle and buffaloes are the most important reservoirs of *S. japonicum* infection, especially in the lake regions. Their relative potential contamination index may be as high as 70–90% in the lake regions (Mao, 1987).

Experiences have been gained with synchronous chemotherapy in the marshland and lake areas. For example, a longitudinal observation on synchronous chemotherapy was carried out in 30 pilot villages of the Dongting Lake area between 1987 and 1994. Persons who came into contact with infested water, had signs or symptoms of schistosomiasis japonica, or had a positive serological test were given a dose of praziquantel. At the same time yearly chemotherapy was administered to bovines without prior screening. The infection rates in humans were monitored. At the beginning of the project, the human infection rate was 8.2% and the geometric mean intensity of the infection in the whole population was 5.2 EPG. By the end of the project in 1994, the comparative data were 4.2% and 2.0 EPG, respectively. Both prevalence and infection intensity reductions were statistically significant ($P < 0.01$) (Chen et al., 1998). The success of this strategy was also evidenced by the reduction of schistosome-related signs and symptoms among the population (Chen, 1996). However, further reduction of the prevalence below 4.2% proved difficult, even though the source of the infection was being decreased by frequent chemotherapy. This is probably explained by the fact that suitable snail habitats were still available, and hence transmission could not be interrupted.

### 3.4. Remaining challenges

With praziquantel-based chemotherapy serving as the backbone of China's national schistosomiasis control programme over the past two decades, there is a need to carefully examine the acceptability and cost-effectiveness of different chemotherapeutic strategies, including issues of sustainability. In highly endemic areas with *S. japonicum* prevalence exceeding 15%, mass chemotherapy was the strategy of choice during the 1990s. However, after repeated rounds of chemotherapy, compliance decreased (Guo et al., 2005). In areas where the prevalence decreases sharply, the control strategy may be altered to selective chemotherapy after screening with serological tests or faecal examination (Lin et al., 2002), to mass chemotherapy every other year, or to a strategy termed 'passive chemotherapy' (Guo et al., 2005). A cost-effectiveness analysis revealed that lower per capita costs were incurred among villagers receiving chemotherapy after a serological test had been employed (Wu et al., 2000).

Selective chemotherapy was tested in the treatment of persons in a heavily endemic area on an islet in the Poyang Lake for four consecutive years. The prevalence was as high as 39.3% before the intervention. Treatment was only given to persons with eggs in faeces, as diagnosed via yearly faecal examination using the Kato-Katz technique. After the 4-year intervention, the prevalence was 28.6% and there was a decrease in the number of heavily infected individuals. Intensity of infection in the population, which was 59.7 EPG before the intervention, decreased to 37.0 EPG when the project ceased. Morbidity indices decreased concurrently. According to ultrasonography, prevalence of hepatomegaly ($\geq$3 cm below the xiphoid) reduced from 89.2% to 53.4%, and that of splenomegaly from 28.2% to only 1.3%. The observation showed that although selective chemotherapy, given to faecal egg positive persons cannot control the transmission significantly, prevalence and intensity of the infection decreased, and as a result, the risk of clinical complications was also reduced (Jiang et al., 1997).

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