

EPIDEMIOLOGY AND CONTROL OF CLONORCHIASIS IN KOREA

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Clonorchis sinensis (Cobbold, 1875) Looss, 1907, the Chinese or oriental "liver fluke" has been well known as a parasite of major public health importance not only in Korea but also in several East and South-east Asian countries. In Korea, human infection with this fluke was first known in 1912, and has been proven to be highly prevalent along 5 major rivers in southern parts of Korea. Currently the national egg-positive rate among randomly selected Korean people was 2.1% in 1992. The fresh water snail, *Parafossarulus manchouricus*, was found to be the first intermediate host, and approximately 36 species of fresh water fish were verified as the second intermediate host. Human infection with this fluke occurs usually by consumption of infected fresh-water fish in raw condition. Egg count in terms of EPG important in estimating the individual worm load and quantitative analysis of the epidemiological status. Avoidance of raw fish eating should be the most effective measures for prevention but it is extremely hard to carry out in endemic areas. Chemotherapy of infected people with praziquantel appears to be the most practical and efficient measure for control of this fluke infection.

DISTRIBUTION AND PREVALENCE

The first nationwide survey of clonorchiasis by eggs was conducted by the Ministry of Health and Social Affairs in 1958. According to the results of this survey the total number of inhabitants examined at 7 river basins was 14,519 of which 1,701 (11.7%) were found to be infected (Rim *et al*, 1973).

During the 1960s, overall epidemiological surveys were actively carried out throughout the country. From these surveys, it became clear that endemic areas of clonorchiasis were scattered all over the country along the Nakdong, Kum, Mankyong, Yeongsan and Han rivers and the most extensive and intensive endemic regions were found mainly along the Nakdong River. Seo *et al* (1981) examined

the stools of 13,373 people living within 6 km of several riversides in order to investigate the actual status of *C. sinensis* infection among riverside inhabitants. The survey results showed an overall infection rate of 21.5%. An infection rate of 40.2% in the Nakdong River basin ranked first, 30.8% in the Yeongsan River basin second, 17.3% in the Seomjin River basin third, 15.9% in the Tamjin River basin fourth, 15.7% in the South Han River basin fifth, 12.0% in the Kum River basin sixth and 8.0% in the Mangyong River basin last. They estimated the number of people infected with *C. sinensis* at approximately 830,000 to 890,000 of the total 4 million inhabitants of the above 7 basins. According to Song *et al* (1983), generally inhabitants living along riversides showed relatively high rates whereas those living in regions not connected with the rivers or in places near the seashore rarely showed *C. sinensis* eggs. However in certain areas which is not directly drained by the rivers, the inhabitants showed rather high rates of infection.

Since 1971, prevalence surveys of intestinal parasitic infections have been undertaken every 5 years by the Korean Association of Health (KAH) under the direction of the Ministry of Health and Social Affairs (MHSA), Republic of Korea. Nationwide surveys of randomly-selected sample populations in urban rural areas were conducted in 1971, 1976, 1981, 1986 and 1992. According to these survey results, the prevalence of *Clonorchis sinensis* was 4.6%, 1.8%, 2.6%, 2.7% and 2.1%, respectively. Therefore, the infection status of *C. sinensis* remained virtually unchanged over 20 years despite the development of effective anthelmintics such as praziquantel.

INTERMEDIATE HOSTS

The geographical distribution of clonorchiasis closely parallels the distribution of the intermediate host, particularly the snail host, known as *Parafossarulus manchouricus*. This snail is the only

known molluscan host for *C. sinensis* in Korea. The prevalence of *C. sinensis* cercariae in the snail, *P. manchouricus*, collected from endemic areas in Korea were reported to be as low as 0.08% to 3.1% (Rim, 1986). In endemic regions in the basins of the Nakdong River, the population density of snails usually ranged from 200 to 500/m² in the areas of snail habitat during the summer (Report of Korea Association for Parasite Eradication, 1978). Considering the large population of snails found in many bodies of water and the large numbers of shedding cercariae from an infected snail, such a low infection rate in the snails is still highly significant in terms of propagation of the infection. In Korea, the shedding of cercariae from snails was generally observed during the period from May to October (Chun, 1963; Kim, 1974).

Approximately 36 species of freshwater fish were found to serve as second-intermediate hosts in Korea. The majority of these fish belong to the family Cyprinidae. Among these fish, infection of *C. sinensis* metacercariae was found most frequently in *Pseudorasbora parva*, *Sarcocheilichthys sinensis*, *Hemibarbus labeo*, *Acanthorhodeus gracilis*, *A. taenianalis*, *Puntungia herzi*, *Pseudogobio esocinus*, *Gnathopogon* species, and *Acheilognathus limbata*. *P. parva* showed an extremely high degree of infection, usually hundreds to thousands of the metacercariae in a fish, with maximum of 31,516 (Kim, 1974). In Goyang Gun, Kyonggi Do, the maximum number of metacercariae per gram of flesh of this fish was 6,090. In the lower basins of the Nakdong River (in Kimhae Gun), the mean number of metacercariae per gram of flesh of *P. parva* ranged from 46.7 to 3,189.4 in different localities (Kim, 1974). According to reports summarized by the Korea Association for Parasite Eradication (KAPE) in 1978, the most frequently infected fish was *Pseudorasbora parva* 90.3%, followed by *Sarcocheilichthys sinensis* 78.0%, *Hemibarbus labeo* 68.2%, *Puntungia herzi* 50.9%, *Pseudogobio esocinus* 47.5%, *Gnathopogon* species 44.4%, *Cultricus kneri* 38.5% and *Acanthorhodeus taenianalis* 29.5%. Choi *et al* (1976) examined the intensity of infection with larvae in various freshwater fish from the Kumho River, one of the tributaries of the Nakdong River. In their results, *Pseudorasbora parva* was the most heavily infected, and the mean number of metacercariae per gram of flesh was 51.4. *Puntungia herzi*, *Gnathopogon* species, *Pseudogobio esocinus*, *Sarcocheilichthys sinensis*, and *Hemibarbus labeo* were infected moderately (10.4 to 19.5%), whereas *Acheilognathus rhombea*, *Acheilognathus limbata*, and *Acanthor-*

hodeus taenianalis were infected with only a few cysts (1.5 to 3.3%). Park *et al* (1984) compared the metacercarial density of *Pseudorasbora parva* in a period of 10 years on the Kimhae area which is one of the high endemic areas. Although the metacercarial infection rate of *P. parva* did not change the metacercarial density decreased from 1,312.4 metacercariae/fish in 1972 and 1,233.4 metacercariae/fish in 1973 to 160.8 metacercariae/fish in 1983.

RESERVOIR HOSTS

A survey on reservoir hosts was conducted in Korea by Kim (1974) who examined the prevalence of *C. sinensis* infection in animals (hogs, dogs and house rats) in high-and low-endemic localities. In Kimhae Gun, the most important endemic area in Korea (68.8% of the population infected). He found that 59 (18.5%) out of 319 hogs, 2 out of 4 dogs, and 19 (10.9%) out of 174 house rats were infected. In Goyang Gun a relatively low endemic area (15.2% of the population infected). 2.4% (2/84) of the hogs, 21.6% (11/51) of the dogs, and 3.8% (14/368) of the house rats were infected. The prevalence rate of infection among the animals in the high endemic locality was significantly higher than in the low endemic locality. Therefore, in many endemic areas, the reservoir hosts such as hogs and rats may play a significant role in transmitting the eggs of *C. sinensis*. However, in the endemic areas, more humans are infected than reservoir animals. This indicates that infected humans rather than reservoir hosts play a major role in the epidemiology of the disease.

THE MODE OF HUMAN INFECTION

In the mode of human *Clonorchis sinensis* infection is acquired by eating uncooked fish containing infections metacercariae. The intensity of human infection is dependent upon the eating habits of the population. It is well known that the Korean people have a custom of eating raw fish at drinking parties. Therefore, in endemic areas, more men are infected than women. The incidence in children is low, but from 20 years of age onwards the incidence increases, being the highest at 40 to 50 year of age.

The large fish, *Cyprinus carpio* and *Carassius carassius*, which are frequently eaten by the infestation. in endemic areas, have low rates of infection. However, repeated consumption of the raw fish may lead to heavy infections and high incidence. In most

endemic areas, people consider raw fish a health food. Sometimes, ignorant Korean mothers feed raw fish to their children believing that it will help them grow strong. On the other hand, heavily infected small fish are not generally eaten raw, but they may be undercooked and still transmit infection (Rim, 1986).

QUANTITATIVE EPIDEMIOLOGY

In 1970s epidemiological research on clonorchiasis was carried out most actively in Korea. In the correlation of *C. sinensis* infection with epidemiological and clinical significance, a quantitative examination of stool was greatly helpful. Stoll's egg counting method is especially suitable for field work. The egg count in terms of numbers of eggs per gram of feces (EPG) is important in estimating the worm load and is applicable in quantitative analysis of infection as well as in assessing the efficacy of treatment.

In order to observe the endemicity of *C. sinensis* infection, Rim (1984) attempted a quantitative epidemiological analysis on the levels of intensity or endemicity, age and sex distribution, the features of transmitting *C. sinensis* infection, as well as the epidemiological changes of clonorchiasis including familial aggregations in highly endemic areas. The degrees of intensity or endemicity of *C. sinensis* infection in endemic areas were compared by the regression lines compiled with regression equations, which were calculated by the cumulative percentage of EPG number of *C. sinensis* infection in the surveyed areas. Quantitative analysis on the age and sex distribution and the features of transmitting infection as well as epidemiological changes in the endemic areas were applied by the Muench's catalytic model. It was noted that the theoretically obtained simple and two-stage catalytic curves fitted so well with the observed data and that the catalytic model was found useful in understanding the epidemiological features of the transmission of *C. sinensis* infection (Park *et al*, 1984; Rim, 1986).

CONTROL

The control of clonorchiasis is theoretically very simple, because the infection can only be contracted by ingestion of encysted metacercariae when the raw intermediate host (freshwater fish) is eaten. Therefore, the most practical method of preventing human infection is to avoid eating raw, freshly pickled, or imperfectly cooked freshwater fish (Rim, 1982).

However, it is exceedingly difficult to carry out such simple measures in the face of centuries-old traditions of eating raw fish, to which the population clings with great tenacity.

According to Choi *et al* (1976), who compared to prevalence rate of clonorchiasis in certain areas with attempting health education through 1964 to 1976, a marked reduction in prevalence was encountered in the younger age group, but there was no significant difference in the older age groups. The overall prevalence rate for clonorchiasis was reduced from 27.7% to 19.6% during a 12 year period. They concluded that health education was somewhat influential in the general decrease in infection.

In the control of clonorchiasis in Korea, the practical control measures were not attempted until praziquantel was found as a safe and effective drug against *C. sinensis* in 1981. Rim *et al* (1979, 1981) described that for the complete treatment of clonorchiasis 25 mg praziquantel per kg of body weight should be administered orally 3 times a day (at interval of 5 or 6 hours) for two days. With a dosage of 3x25 mg/kg, even in a single day, more than 85.0% were cured and an egg reduction rate of 99.5% was obtained. Praziquantel is very well tolerated, and side effects consist of mild and transient headache and dizziness.

The Ministry of Health and Social Affairs (MHSA) and the Korea Association for Parasite Eradication (KAPE) conducted a pilot project of treatment for clonorchiasis using praziquantel in 1982 in order to find the most convenient and effective dosage schedule of the drug when used in mass chemotherapeutic control. In the results, a single dose of 40 mg/kg of praziquantel was recommended for large-scale treatment of *C. sinensis* infection under field conditions (MHSA and KAPE, 1982; Lee, 1984).

The government launched the mass treatment project of clonorchiasis in 1984. During 7 years of 1984 to 1990, a total of 3,009,166 people who were living in endemic areas were examined microscopically by cellophane feces thick smear method. Each egg-positive cases were treated with praziquantel in a single dose of 40 mg/kg of body weight at local health centers under the physicians supervision (MHSA and KAH, 1992). In the results, the egg positive rates in inhabitants of the project areas were 13.3% of 168,877 people examined in 1984; 7.0% of 447,237 in 1985; 2.2% of 496,835 in 1986; 1.8% of 502,026 in 1987; 1.2% of 488,553 in 1988; 0.9% of 496,361

in 1989 and 0.9% of 409,277 in 1990. After the mass treatment project was begun in 1984 in the endemic areas in Korea, the status of clonorchiasis was significantly improved 7 years later. It evidently recognized that not only the infection rates were reduced in the previously endemic areas, but also the proportion of the degree of heavy infection in clonorchiasis has been lowered from 11.9% to 3.6% in the infected people.

Together with the mass treatment, voluntary treatment with praziquantel to the infected individuals was popular. In addition to the chemotherapy, reinfection cycle seems blocked in many previous endemic areas because of a changed ecology due to mechanization of farms, urbanization, industrialization, water pollution, reduced population of freshwater fish caused by the use of chemical fertilizers and pesticides, and the resulting attitude changes of the local people toward eating raw freshwater fish. However, a lots of people who enjoy the habit of eating raw fish remains in certain areas in the basins of rivers. At the present, chemotherapy has proved to be a rapid and effective method of control. Therefore, a combination of efforts with major emphasis on health education and mass treatment with praziquantel coupled with governmental aid could reduce the disease.

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