SNAIL-BORNE PARASITIC ZOONOSES IN KOREA

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Abstract. A total of 22 snail-borne parasites causing various parasitic zoonoses in Korea are listed and reviewed. All of these parasites are indigenous except *Heterophyes heterophyes, H. dispar* and *Angiostrongylus cantonensis* detected in patients who traveled outside of Korea.

INTRODUCTION

It is well known that the presence of susceptible snail hosts are the primary requirement for the establishment of trematode and a few nematode parasites in an area. Since these snails have special habitat requirements and geographical distribution, it follows that the snail-borne parasites also have a spotty distribution, even within the same area. The snail-borne parasitoses occurring both in man and animal falls under the category of metazoonoses; requiring both vertebrate and invertebrate (molluscs) hosts in the life cycles.

Table 1 lists the snail-borne trematodes which have been reported as adults in man in Korea, including two trematode species and one nematode species imported from outside the country.

The snail-borne parasitic zoonoses caused by the trematodes listed are reviewed with special reference to clonorchiasis, paragonimiasis and metagonimiasis which are of public health importance in Korea.

CLONORCHIASIS

Clonorchiasis is one of the major endemic diseases in Korea caused by the Chinese liver fluke, *Clonorchis sinensis*. Walton and Chyu (1959) carried out a nationwide skin test survey for the detection of clonorchiasis cases and estimated 4.5 million positive cases out of 30 million Koreans. Chai *et al* (1982) examined 9,572 fecal samples by the cellophane-thick-smear method in army recruits from all parts of South Korea and found 7.3% with *C. sinensis* eggs. Bae *et al* (1983) found a new endemic area for *C. sinensis* infection along the Nam River flowing into Gyeongsang-nam-do of Korea. The overall prevalence of *C. sinensis* infection was 38.7% from 5,291 examinees.

Two bithyniid snail species are involved in the *C. sinensis* life cycle in Korea: *Parafossarulus manchouricus* and *Gabbia misella* (Soh, 1978). However, it has not been definitely established whether *G. misella* serves as an intermediate host. Kim (1974) reported about 2.5–5.2% of the *P. manchouricus* collected in the Gimhae area of Gyeongsang-nam-do, shedding cercariae during the summer season.

Twenty-nine species of freshwater fish have been recorded as second-intermediate hosts (Soh, 1960). Among these *Pseudorasbora parva* of the family Cyprinidae is the most heavily infected with the metacercariae of *C. sinensis*.

Domestic and wild animals in endemic areas play an important role in spreading the eggs of *C. sinensis*. Min (1982) reported egg positive rates of 0.14%–10.0%, 7.3% and 0.33% in dogs, cats and house rats, respectively.

To prevent *C. sinensis* infection in the endemic areas, an effective health education system is suggested as a control measure, along with mass treatment using praziquantel.

PARAGONIMIASIS

Paragonimus westermani has been recognized as the only species of genus *Paragonimus* in Korea. Miyazaki (1978), on the other hand, described two types of lung fluke. Through his extensive cytological studies he proposed only the bisexual type to be *P. westermani*, and the parthenogenetic type *P. pulmonalis* (Baelz, 1880).

Table 1

Medically important trematodes and their molluscan intermediate hosts in Korea.

Trematode	Definitive host	Molluscan intermediate host	
		Species	Family
Liver flukes			
Clonorchis sinensis	Human, dog, cat, rat	*Parafossarulus manchouricus*	Bithyniidae
		Gabbia misella (?)	Bithyniidae
Fasciola hepatica	Sheep, cattle and other herbivores, human	*Fossaria truncatula*	Lymnaeidae
		Austropeplea (= *Lymnaea*) *viridus*	Lymnaeidae
Lung flukes			
Paragonimus westermani	Human, tiger, cat, dog	*Semisulcospira libertina*	Pleuroceridae
Paragonimus pulmonalis	Human, tiger, cat, dog	*Semisulcospira libertina*	Pleuroceridae
Intestinal flukes			
Metagonimus yokogawai	Human, dog, cat, rat, fowl	*Semisulcospira* sp.	Pleuroceridae
M. takahashii	Human, dog, cat, rat, fowl	*Semisulcospira* sp.	Pleuroceridae
Hetrophyes nocens	Mammal, bird, human	–	–
Heterophyopsis continua	Cat, dog, duck, sea gull, human	–	–
Pygidiopsis summa	Bird, cat, dog, rat, human	– (*Tympanotonus microptera*)	–
Stellantchasmus falcatus	Dog, cat, rat, bird, human	– (*Stenomelania sp. Thiara* sp.)	– *Thiariidae* Thiariidae
Centrocestus armatus	Dog, cat, rabbit, bird, human	–	–
Stictodora fuscatum	Bird, mammal, human	–	–
Fibricola seoulensis	rat, dog, human	*Hippeutis cantori*	Planorbidae
Echinostoma hortense	Rat, dog, human	*Radix auricularia*	Lymnaeidae
E. cinetorchis	Rat, human	*Hippeutis cantori*	Planorbidae
		*Hippeutis cantori**	Planorbidae
		*Radix auricularia**	Lymnaeidae
		*Physa acuta**	Physidae

continued from Table 1

Trematode	Definitive host	Molluscan intermediate host	
		Species	Family
Echinochasmus japonicus	Dog, cat, rat, bird, human	*Parafossarulus manchouricus*	Bithyniidae
Plagiorchis sp.	Rat, bird, human	– (*Lymnaea* sp.)	Lymnaeidae
Gymnophalloides sp.	Rat, bird, human	*Crassostrea gigas**	Ostreidae
Pancreatic fluke			
Eurytrema pancreaticum	Sheep, cattle, human	*Acusta despecta*	Xanthonychidae
Snail-borne parasites introduced from outside			
Heterophyes heterophyes	Human, cat, dog, fox, pelican	– (*Cerithidae cingulata Pironella conica*)	– Potamidae (= Cerithiidae)
H. dispar	Human, dog, cat, carnivores	–	–
*Angiostrongylus cantonensis***	Rodent, human	– (*Achatina fulica Pila* spp.)	– Achatinidae Ampullariidae

Remarks : ? = suspicious sp.
– = not detected in Korea
* = serves as the 2nd intermediate host
** = imported snail-borne nematode

Walton and Chyu (1959) reported 1,229 positive reactors out of 9,771 persons skin tested. The highest prevalence occurred in Cheju Do Island (47%) and the lowest in Kyong-gi Do (3%). Although massive application of new effective drugs and health education contributed greatly to attain the drastic reduction of infection rates, there are still spotty epidemic foci in Korea.

The snail intermediate hosts of *P. westermani* all belong to the family Pleuroceridae. *Semisulcospira libertina* is the most important first-intermediate host among 7 species of genus *Semisulcospira* in Korea (Chung, 1983). However, the taxonomic validity of these species is still open to question, as well as their susceptibilities to infection with *P. westermani*.

The crustacean hosts of *P. westermani* are the "hairy crab", *Eriocheir sinensis* and *Gambaroides similis*. Soh *et al* (1966) examined the freshwater shrimp *Macrobachium nipponensis* in Korea for the metacercariae of *P. westermani*, and found that 6 out of 4,382 shrimps examined were infected.

Domestic and wild animal definitive hosts of *P. westermani*, are dogs, cats, pigs, cattle, tigers, panthers, foxes, wolves and wild cats (Seo, 1969). Cattle have also been cited as a definitive host in Korea. Epidemiologic surveys on domestic and wild animals have not been done.

The most probable mode of human infection is from eating raw crabs immersed in soy

sauce. Also, the raw juice of the crushed crayfish is used as medicine for measles especially in rural Korea. These food habits and socio-cultural factor remain the main cause for the continued presence of *P. westermani* infections in Korea.

METAGONIMIASIS

Two species of genus *Metagonimus*, *M. yokogawai* and *M. takahashi* have been listed as the causative agents of metagonimiasis in Korea. *Metagonimus* infections are known to be distributed mainly in the southern parts of Korea. Soh *et al* (1976) reported a high prevalence of metagonimiasis in the Seomjin River area of Choola-nam Do where the egg positive rate among 296 examinees was 41.6%. Recently, Ahn *et al* (1987) carried out an epidemiological survey for *Metagonimus* infection along the eastern coastal area of Kangwon Province, and determined a prevalence rate of 6.6% in 2,357 stool specimens.

The cercarial infection rates of the snails, *Semisulcospira* spp., are thought to reflect the degree of the stream contamination with human excreta containing ova (Chai *et al*, 1977).

Many salmonoid and cyprinoid fish have been found to harbor the metacercariae of *Metagonimus* spp. Among these, *Plecoglossus altivelis, Pseudorasbora parva* and *Carassius carassius* are considered the main sources of human infection (Soh, 1978). The sweetfish, *P. altivelis*, is a favorite and eaten raw in Korea, and seems always to be related with human infection.

FASCIOLIASIS

Brooks *et al* (1956) reported *Fasciola*-like eggs in six of 1,726 stool specimens examined from a prisoners of war in a camp in Kojedo. The eggs could not be identified as either *Fasciola* spp. or *Fasciolopsis* sp. *Fasciola* eggs may appear in stool specimens after eating infected sheep or cattle livers, which are considered spurious infections.

While *F. hepatica* infection in cattle is relatively common, only 7 human fascioliasis cases has been reported so far in Korea (Im and Kim, 1988).

Two lymaeid snail species, *Fossaria truncatula* and *Austropeplea viridus*, play an important role as the first intermediate hosts of *F. hepatica* in Korea.

DICROCOELIID FLUKES

Two dicrocoeliid fluke species, *Dicrocoelium dendriticum* and *Eurytrema pancreaticum*, are in the family Dicrocoeliidae. A human case continuously showing dicrocoeliid eggs in stool specimens has been reported and is regarded as the first case of *E. pancreaticum* infection in Korea (Im and Koh, 1971). The eggs of *D. dendriticum* are indistinguishable from those of *E. pancreaticum*, but the above case is considered a real infection with *E. pancreaticum*.

Jang (1969) has completed the life cycle of *E. pancreaticum* in an enzootic area of Korea, and found a land snail, *Acusta despecta*, serving as the first intermediate host of this pancreatic fluke. He has also observed metacercarial development of this fluke in the tettigoniid grasshoppers, *Conocephalus maculatus* and *C. gladiatius*.

OTHER INTESTINAL FLUKE INFECTIONS

Metagonimus yokogawai is the most prevalent intestinal fluke among 14 indigenous species in Korea listed in Table 1. Most of the intestinal flukes except *M. yokogawai* have been recovered from humans in Korea during the 1980s.

Among 10 heterophyid species, *Heterophyes heterophyes* and *H. dispar* were detected in the Korean workers who had been in the Middle East. Three species belonging to the family Echinostomatidae have also recently been reported in Korea. Several freshwater and brackish water fishes serve as the second intermediate hosts of the above mentioned heterophyids and echinostomes (Table 1). It is interesting that the first intermediate snail host of *Echinostoma cinetorchis*, *Hippeutis cantori*, also serves as a second-intermediate host.

Fibricola seoulensis of the family Diplostomatidae was first described by Seo *et al* (1982) from the small intestine of house rats, *Rattus norvegicus*, in Seoul, Korea, and a total of 26

human cases have been reported so far. Several species of terrestrial snakes were found to be the second-intermediate or paratenic hosts of *F. seoulensis*.

An interesting epidemiological finding was the recovery of the metacercarial stage of *Gymnophalloides* sp. in an oyster, while the larval stages of *Plagiorchis* sp. have not yet been discovered in Korea.

Ten human angiostrongyliasis cases caused by a mulluscs transmitted nematode, *Angiostrongylus cantonensis*, have been reported in Korea (Lee *et al*, 1981). The patients were all Korean workers who had been in Samoa.

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