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Comparative Morphology of Eggs of Heterophyids and *Clonorchis sinensis* Causing Human Infections in Korea

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INTRODUCTION

Clonorchis sinensis, *Paragonimus westermani* and *Metagonimus yokogawai* are three major trematodes of man in Korea. Some other kinds, especially intestinal flukes, have also been reported and those belonging to family Heterophyidae, *i.e.*, heterophyids, are the important ones. The species of heterophyids, other than *M. yokogawai*, are *Heterophyes heterophyes nocens* (Seo *et al.*, 1980; Chai *et al.*, 1984), *Heterophyopsis continua* (Seo *et al.*, 1984a), *Stellantchasmus falcatus* (Seo *et al.*, 1984b), *Pygidiopsis summa* (Seo *et al.*, 1981) and *Stictodora* sp. (Seo *et al.*, 1983).

Intestinal helminths in general are diagnosed conveniently by fecal examination for their eggs. However, the eggs of heterophyids are much alike one another and even resemble those of *C. sinensis*. Therefore, it is known that species diagnosis on the eggs is much difficult and adult worms should be obtained to determine the exact species. Because of such difficulty human cases infected by heterophyids other than *M. yokogawai* have not been properly diagnosed in mass fecal examinations but seem to have been simply regarded as *M. yokogawai* or even as *C. sinensis*.

In this respect, in order to detect suspected human cases of heterophyid infection in fecal examination, it is greatly needed to make some differential keys on the morphology of their eggs. This study was performed to observe the comparative morphological features of the eggs of 5 kinds of heterophyids and *C. sinensis* known to infect man in Korea.

MATERIALS AND METHODS

All of the eggs of *C. sinensis* and 5 kinds of heterophyids, *M. yokogawai*, *H. heterophyes nocens*, *H. continua*, *S. falcatus* and *P. summa*, observed in this study were obtained from the distal portion of uteri of each species collected from men either at surgical table (*C. sinensis*) or after treatment with praziquantel or bithionol followed by purgation with magnesium salt (heterophyids). Before the treatment of heterophyid infection cases, they were tentatively diagnosed either by the presence of eggs in feces or by gastrointestinal symptoms with history of eating raw flesh of brackish water fishes which are known as the second intermediate hosts in this country. The adult flukes collected from the patients were fixed with several drops of 10% formalin solution under cover slip pressure and their species determined by detailed morphological observations under light microscopy.

For observation of intrauterine eggs 10~20 specimens each of 6 kinds of flukes were used. They were put on the center of slide glasses with small drops of formalin solution and distal portions of uterine tubule were opened with a sharp-pointed pin under careful observation with stereomicroscope in order to obtain most mature

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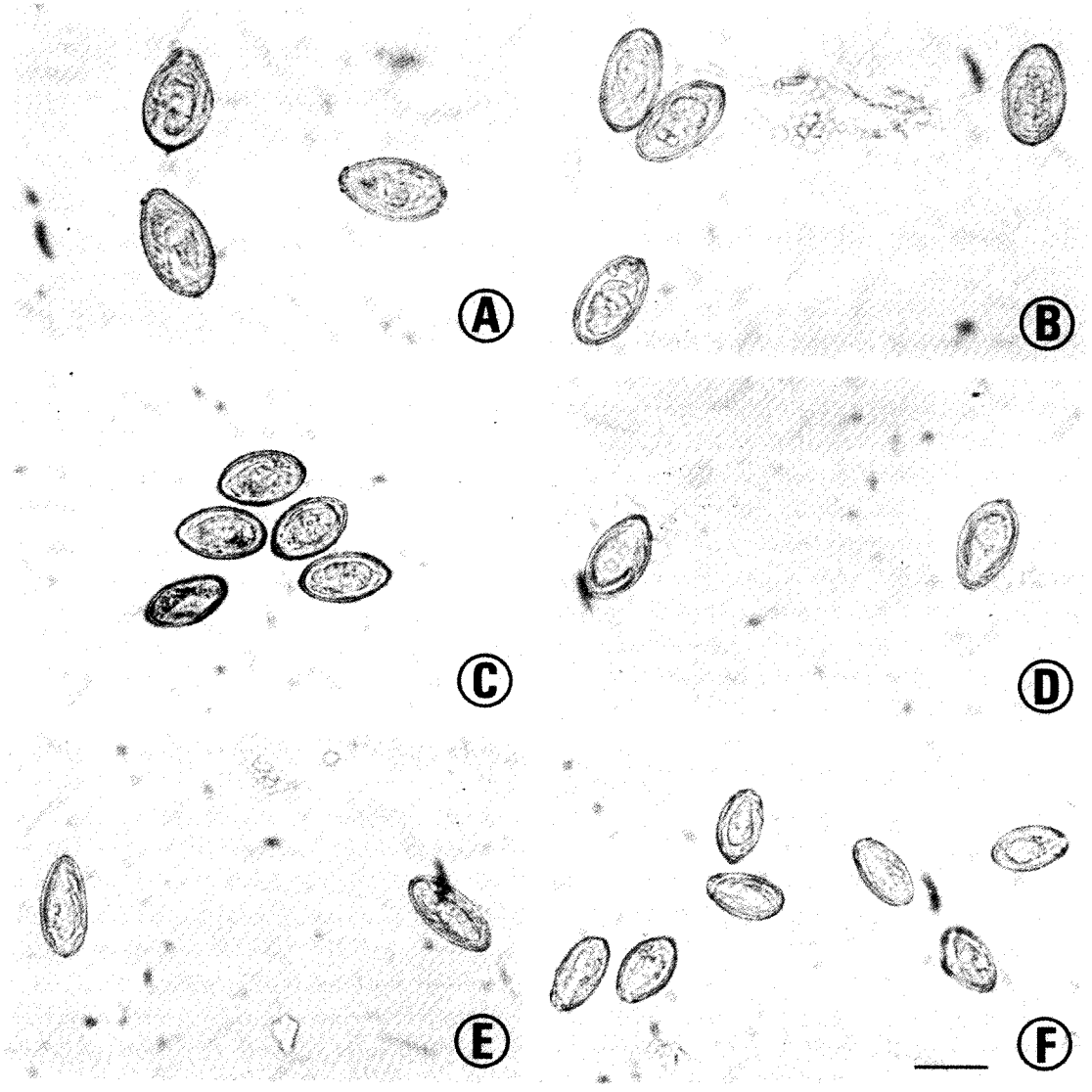

Fig. 1. Comparative view of *C. sinensis* and heterophyid eggs (all of the eggs are are photographed under the same magnification).
A: *C. sinensis*, B: *M. yokogawai*, C: *H. h. nocens*, D: *H. continua*, E: *S. falcatus* and F: *Pygidiopsis summa* (Scale: 20μm)

eggs. After removing fragments of worm bodies from the slide, mixture of uterine content and formalin was covered with a cover slip and observed. Observation was performed on as many eggs as possible but measurements were done on 50 randomly selected ones for each fluke. Each egg was photographed by an automatic photomicroscope (Photomax, Olympus Co.) at 400× magnification.

RESULTS

1. Shape or Appearance of Heterophyid and *C. sinensis* Eggs

Among various morphological features of eggs of 6 kinds of flukes (Table 1) the most prominent differential point between heterophyids and *C. sinensis* was the presence of muskmelon pattern (wrinklings) at shell surface in the latter (Fig. 1-A) while not in the formers (Fig. 1-B, 1-C, 1-D, 1-E and 1-F). Even in eggs of *C. sinensis*, sometimes the muskmelon pattern was not so prominent (10~20% of eggs observed). In such case, however, other characteristics such as size, shape, prominence of operculum and shoulder rims, terminal protuberance, *etc.* were helpful for diagnosis.

Eggs of *P. summa* and *S. falcatus* are elongated ovoidal in general shape and slightly resemble those of *C. sinensis*. But *P. summa* eggs are not so elongated but rather pyriform in shape and *S. falcatus* eggs are more elongated and slender than *C. sinensis* (Fig. 1-A, 1-E and 1-F). Eggs of *H. continua* are more broadly oval in shape compared with *C. sinensis* (Fig. 1-A and 1-D). In cases of *M. yokogawai* and *H. h. nocens*, their eggs are ellipsoid to elliptical or ovoid in shape with equally ending anterior and posterior ends (Fig. 1-B and 1-C), which is apparently different from *C. sinensis* having more attenuated anterior end. By egg shape, *H. h. nocens* is differentiated from *M. yokogawai* in that the former has a little pointed both ends, otherwise the two are much similar in appearance (Fig. 1-B and 1-C).

2. Measurements of Heterophyid and *C. sinensis* Eggs

In order to discriminate 6 kinds of eggs, the length, width and their ratio (length/width) were measured and compared (Table 2, 3, 4 and 5). The range (average value) of egg length in the order from smaller one was 19.8~22.9 (21.6) μm for *P. summa*, 23.7~27.7 (25.0) μm for *H. continua*, 23.7~29.2 (25.7) μm for *H. h. nocens*, 25.3~29.2 (27.2) μm for *S. falcatus*, 26.9~31.6 (28.5) μm for *M. yokogawai* and 25.3~33.2 (28.3) μm for *C. sinensis* (Table 2). The length distribution of 50 eggs of each species was also compared (Table 3). Egg length appears to be a good criteria for discrimination

Table 1. Comparative morphology of heterophyid and *C. sinensis* eggs in worms collected from man in Korea

Fluke	Eggs		
	Shape	Colour	Muskmelon pattern
M. yokogawai	Ellipsoid to elliptical, operculum not prominent, both ends round	Yellowish or dark brown	Not prominent
H. h. nocens	Ellipsoid to ovoid with a little pointed both ends, smaller than *M. yokogawai*	Light brown	Not prominent
S. falcatus	Elongated ovoidal sometimes with a little attenuated anterior end, more slender than *C. sinensis*	Yellowish brown	Not prominent
H. continua	Broadly oval, length relatively shorter than *M. yokogawai* but width as broad as that	Very light yellow	Not prominent
P. summa	Ovoid to pyriform with more or less prominent operculum, shoulder rims, attenuated anterior end, smallest size	Light yellow	Not prominent
C. sinensis	Elongated ovoidal with prominent operculum, shoulder rims and attenuated anterior end	Light yellowish brown	Prominent

Table 2. Comparative measurements of heterophyid and *C. sinensis* eggs in worms collected fom man

Fluke	Fgg length(μm)	Egg width (μm)	Length/Width
	*Range (Mean)	*Range (Mean)	Range (Mean)
M. yokogawai	26.9~31.6 (28.5)	14.2~18.2 (16.8)	1.48~2.11 (1.70)
S. falcatus	25.3~29.2 (27.2)	11.1~13.4 (12.5)	2.00~2.57 (2.17)
H. h. nocens	23.7~29.2 (25.7)	14.2~15.8 (15.4)	1.50~2.06 (1.67)
H. continua	23.7~27.7 (25.0)	15.8~18.9 (16.4)	1.33~1.75 (1.53)
P. summa	19.8~22.9 (21.6)	11.1~13.4 (12.1)	1.63~1.99 (1.78)
C. sinensis	25.3~33.2 (28.3)	14.2~17.4 (15.9)	1.60~2.00 (1.78)

* No. eggs measured: 50 eggs for each fluke species

Table 3. Distribution of length of heterophyid and *C. sinensis* eggs in worms collected from man

Egg length (μm)	% to total eggs measured					
	*P.s.	H.c.	H.h.n.	S.f.	M.y.	C.s.
19.0~20.4	2	0	0	0	0	0
20.5~21.9	**32	0	0	0	0	0
22.0~23.4	66	0	0	0	0	0
23.5~24.9	0	24	22	0	0	0
25.0~26.4	0	**68	**46	16	0	10
26.5~27.9	0	8	24	**46	26	38
28.0~29.4	0	0	8	38	**52	**20
29.5~30.9	0	0	0	0	16	20
31.0~32.4	0	0	0	0	6	10
32.5~33.9	0	0	0	0	0	2

* *P.s.* : *Pygidiopsis summa*, *H.c.* : *Heterophyopsis continua*, *H.h.n.* : *Heterophyes h. nocens*, *S.f.* : *Stellantchasmus falcatus*, *M.y.* : *Metagonimus yokogawai*, *C.s.*: *Clonorchis sinensis*

** Average value falls in this range

of *P. summa* from other flukes (Table 2, 3 and Fig. 2). However, other 4 kinds of heterophyids are not easily distinguished one another and from *C. sinensis* because the length ranges were sometimes largely overlapped (Fig. 2). Especially *M. yokogawai* and *S. falcatus* were much overlapped each other and by *C. sinensis* (Table 3). But in comparison, the distribution pattern of egg length of *H. continua* and *H. h. nocens* was considerably different from *C. sinensis*, *M. yokogawai* and *S. falcatus*, and the average values smaller than the latters (Table 3).

The range (average value) of egg width in the order from slender one was 11.1~13.4 (12.1) μm for *P. summa*, 11.1~13.4 (12.5) μm for *S. falcatus*, 14.2~15.8 (15.4) μm for *H. h. nocens*, 14.2~17.4 (15.9) μm for *C. sinensis*, 15.8~18.9 (16.4) μm for *H. continua* and 14.2~18.2 (16.8) μm for *M. yokogawai* (Table

Table 4. Distribution of width of heterophyid and *C. sinensis* eggs in worms collected from man

Egg width (μm)	% to total eggs measured					
	*P.s.	S.f.	H.h.n.	H.c.	M.y.	C.s.
11.0~11.9	34	14	0	0	0	0
12.0~12.9	**64	**78	0	0	0	0
13.0~13.9	2	8	0	0	0	0
14.0~14.9	0	0	18	0	2	4
15.0~15.9	0	0	**82	66	36	**88
16.0~16.9	0	0	0	**6	**6	4
17.0~17.9	0	0	0	22	42	4
18.0~18.9	0	0	0	6	14	0

* Same abbreviations as in Table 3

** Average value falls in this range

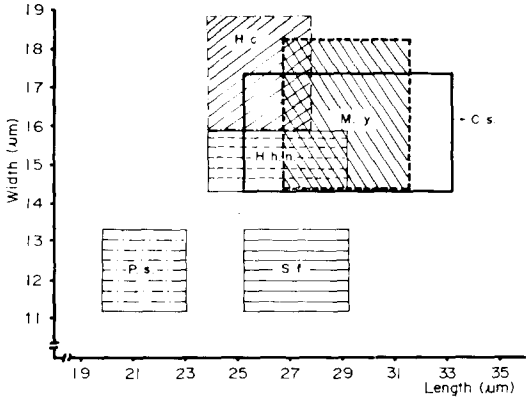

Fig. 2. Comparative egg size of 5 kinds of heterophyid flukes and *C. sinensis*

Table 5. Distribution of the ratio of length/width of heterophyid and *C. sinensis* eggs in worms collected from man

Ratio (length/width)	% to total eggs measured					
	H.c.	*H.h.n.*	*M.y.*	*P.s.*	*S.f.*	*C.s.*
1.30～1.39	10	0	0	0	0	0
1.40～1.49	16	0	2	0	0	0
1.50～1.59	**26	20	28	0	0	0
1.60～1.69	44	**42	26	20	0	8
1.70～1.79	4	22	**6	**48	0	**40
1.80～1.89	0	8	20	14	0	24
1.90～1.99	0	0	14	18	0	22
2.00～2.09	0	8	4	0	14	6
2.10～2.19	0	0	0	0	**48	0
2.20 & over	0	0	0	0	38	0

* Same abbreviations as in Table 3
** Average value falls in this range

2). Also the width distribution of 50 eggs each was compared by fluke species (Table 4). The width of 3 kinds of heterophyid eggs, *H. h. nocens*, *H. continua* and *M. yokogawai*, were overlapped by *C. sinensis*. However, the distribution pattern of egg width of *H. h. nocens* was a little different from other 3 flukes in that some of them (9 of 50 eggs measured) were less than 15μm in width while hardly so in the latter flukes (Table 4). Especially many eggs of *M. yokogawai* (31 of 50 measured) were over 16.0 μm in width. Therefore, the egg width is considered to be useful for differentiation of *H. h. nocens* and *M. yokogawai*. The most distinct species in their egg width are *P. summa* and *S. falcatus*. They appeared to be almost always less than 13.0μm in width while not in other 4 kinds of flukes (Table 4 and Fig. 2). However, only by their egg width, it is hardly possible to discriminate *H. continua*, *M. yokogawai* and *C. sinensis*.

To support the differential diagnosis, an egg measurement index (ratio of length/width) was prepared on 6 kinds of eggs (Table 2 and 5). There were some unusual eggs in each species revealing extreme values and making larger overlappings between the species, however, the majority were within some limited ranges. The range of index (average) in over 80% of measured eggs were 1.40～1.69 (1.53) for *H. continua*, 1.50～1.79 (1.67) for *H. h. nocens*, 1.50～1.89 (1.70) for *M. yokogawai*, 1.60～1.89 (1.78) for *P. summa*, 1.70～1.99 (1.78) for *C. sinensis* and 2.00～2.29 (2.17) for *S. falcatus* (Table 2 and 5). These results suggest that the ratio is another good criteria for egg differentiation. However, even with this ratio, the discrimination of *H. h. nocens*, *M. yokogawai* and *C. sinensis* is not yet possible unless the egg shape is put into considerations together.

DISCUSSION

So far as the literatures are concerned, a large number of descriptions are available on the morphology and size of eggs of heterophyid flukes and *C. sinensis* (Table 6). However, there always have been some discrepancies in the measurement values. It seems to have been due to any of the factors such as source of eggs (in stool or in uteri of worms), status of worms (fresh or stained), kinds of host (man or animals), methods of measurement and calculation, number of eggs measured, and bias between examiners. Despite above situation, the measurement values given in the present paper are generally acceptable for the representative values of each fluke species (Table 6). However, there are some points to be taken into considerations.

In *M. yokogawai* eggs, it was reported that the length could be as short 23.5μm when obtained from hamsters (Saito, 1972). But it seems not probable in case of human host. The egg size of *M. takahashii*, another species of genus *Metagonimus* (Takahashi, 1929) which was not subjected in this study, are larger than *M. yokogawai* eggs, 30～36μm in length and 18～23μm in width. However, in this study, some larger eggs of *M. yokogawai* can also be over 30μm in length and in such case the discrimination of two species may be much difficult. The eggs of *H. h. nocens* were smaller in worms collected from man in Japan (Suzuki *et al.*, 1982), but it seems due to measurement on stained worms, in which case the eggs are shrunken during the

Table 6. Comparison of egg size of heterophyid flukes and *C. sinensis* reported by various authors

Fluke	Author(year)	Host	Egg length (μm) Range(Mean)	Eggwidth (μm) Range(Mean)	Egg source
M. yokogawai	Yokogawa(1912)	mouse	27.5~30.0(28)	15.5~16.8(16)	Stool
	Saito(1972)	hamster	23.5~31.5(27)	14.5~18.0(16.5)	Stool
	Seo *et al.*(1971)	man	27.0~30.6(28.9)	16.2~18.0(16.9)	Stool
	Present authors	man	26.9~31.6(28.5)	14.2~18.2(16.8)	In uterus
H. h. nocens	Seo *et al.*(1980)	rat	24~27	13~15	In uterus
	Takahashi(1929)	dog	23~27(26)	14~16(16)	In uterus
	Suzuki *et al.*(1982)	man	24.2~25.1	13.9~14.7	In uterus(stained)
	Present authors	man	23.7~29.2(25.7)	14.2~15.8(15.4)	In uterus
S. falcatus	Noda(1959)	kitten	19~25(22)	12~16(13)	Stool
	Onji *et* Nishio(1924)	cat	25~28(27)	13~15(14)	In uterus
	Takahashi(1929)	dog	23~27(26)	12~14(13)	In uterus
	Kagei *et al.*(1964)	man	23.7~26.2(25.0)	11.2~13.3(12.2)	Stool
	Present authors	man	25.3~29.2(27.2)	11.1~13.4(12.5)	In uterus
H. continua	Yamaguti(1939)	bird	25~26	14~16	In uterus(stained)
	Chun(1960)	dog	25~26(25.5)	15~15(15.5)	In uterus(stained)
	Present authors	man	23.7~27.7(25.0)	15.8~18.9(16.4)	In uterus
P. summa	Chun(1963)	rat	19~26	12~14	In uterus(stained?)
	Onji *et* Nishio(1916)	cat	21~23(22)	13~15(14)	In uterus
	Ochi(1931)	cat, dog	18.5~23.0(22)	11~14(12.5)	Stool
	Yokogawa(1965)	man	20~26(23)	11~14(13)	Stool
	Present authors	man	19.8~22.9(21.6)	11.1~13.4(12.1)	In uterus
C. sinensis	Chai(1984)	rabbit	25.3~31.6(27.8)	15.8~17.4(16.0)	In uterus
	Takahashi(1929)	dog	24~31(29)	14~18(16)	In uterus
	Takahashi(1929)	man	27~32(29)	15~18(16)	In uterus
	Present authors	man	25.3~33.2(28.3)	14.2~17.4(15.9)	In uterus

process of dehydration. The length of *S. falcatus* eggs in human stool (Kagei *et al.*, 1964) was also a little smaller than in this study, but it may be a variation. *H. continua* eggs in this study revealed a little wider range in length and width compared with other authors. In *P. summa* eggs, there was a relatively large discrepancy in length between the present specimens and those in stool of man in Japan (Yokogawa *et al.*, 1965). The longest egg in the present specimens was less than 23μm while in stool in Japan it was up to 26μm. It was already indicated by Takahashi (1929) that there exist two types of *P. summa* eggs, the larger (24~26μm in length) and the smaller ones (19~22μm), of which the taxonomical significance has not been elucidated.

Some clues or keys for differential diagnosis of eggs were made in this study with their comparative shape, size and index (length/width) (Table 7). Firstly, eggs of *C. sinensis* are easily differentiated from others by the presence of wrinkling at shell surface. All of other (heterophyid) eggs have very smooth surfaces. *P. summa* eggs are the smallest of all kinds examined, so that they are easily differentiated. Even if the larger type eggs of *P. summa* appeared, they could also be discriminated from *S. falcatus* or *C. sinensis* by their shape and appearance. *S. falcatus* eggs are the next to be differentiated easily from others. They are long and slender in shape with over 2.0 of the index (length/width). Egg shapes of *H. h. nocens* and *C. sinensis* are somewhat similar to those of *S. falcatus*, however, *H. h. nocens* eggs are broader than *S. falcatus*, and *C. sinensis* eggs have distinct operculum and slightly attenuated anterior end. Eggs

Table 7. Key to the 5 species of heterophyids and *C. sinensis* by light microscopy of eggs

1. a)	Eggs with prominent wrinklings at shell surface ..... *C. sinensis*
b)	Eggs with very smooth shell surface ..... 2.
2. a)	Egg length less than 23 μm, pyriform in shape ..... *P. summa*
b)	Egg length over 23 μm ..... 3.
3. a)	Egg width less than 14μm, elongated ovoidal in shape (*L/W over 2.0) ..... *S. falcatus*
b)	Egg width broader than 14 μm, elliptical, ovoid or oval in shape ..... 4.
4. a)	Egg length longer than 27μm, ellipsoid to elliptical in shape, without attenuation at both ends ..... *M. yokogawai*
b)	Egg length not longer than 29 μm, oval or ellipsoid to ovoid in shape, with slight attenuations at anterior and/or posterior ends ..... 5.
5. a)	Egg width broader than 16 μm (L/W less than 1.75), oval in shape, maximum width at post-equatorial portion ..... *H. continua*
b)	Egg width less than 16 μm (L/W up to 2.0), ellipsoid to ovoid in shape, maximum width at equatorial portion with slight attenuations at both ends ..... *H. h. nocens*

*L/W: the ratio of length/width

differentiated with much difficulty from *M. yokogawai* (smaller ones) are *H. continua* and *H. h. nocens*. *M. yokogawai* and *H. continua* eggs differ in two points. In *H. continua* eggs the broadest portion is at posterior half while in *M. yokogawai* (and *H. h. nocens*) it is usually at equatorial portion. The former eggs do have slightly attenuated anterior end while not in the latter. Some eggs of *H. h. nocens* are more slender in shape than *H. continua* or *M. yokogawai* and have a little pointed anterior and posterior ends unlike *M. yokogawai*. In differentiation of *M. yokogawai* eggs from *C. sinensis*, egg colour may sometimes be helpful. The former is yellowish or dark brown in general colour while the latter is light yellowish brown.

In spite of these morphological characteristics of heterophyid and *C. sinensis* eggs, there are still problems in differential diagnosis of human infections by means of fecal examination. One of them is that *C. sinensis* is known to produce several types of abnormal eggs (Ishii, 1929; Yumoto, 1936) which closely resemble those of heterophyids. It was stated by Komiya (1966) that abnormal eggs of *C. sinensis* may appear throughout the life of fluke, however, they are more likely to be produced by young flukes near maturity, by old ones, or as a result of drug treatment. One apparently different feature of these eggs from normal *C. sinensis* or heterophyid eggs is that they usually do not contain miracidia, and instead, have granule-like structures of variable size. And they lack all other characteristic features of *C. sinensis* eggs such as wrinkling at shell surface. Therefore, eggs that have granules instead of miracidia should be excluded from consideration in differential diagnosis. A problem in differential diagnosis is also met in cases of mixed infection by *C. sinensis*, *M. yokogawai*, *H. h. nocens*, or others. Careful observation and measurement on many eggs may be helpful to know the combination of diagnosis, however, it seems practically very difficult. In such cases, it is recommended that the adult flukes be pursued by treatment and purgation of the patients.

By fecal examination in Japan, specific diagnosis on some heterophyid infections was performed. A total of 105 and 20 egg positive cases of *P. summa* and *S. falcatus* respectively were detected among the natives of Okayama district (Takahashi, 1929). His diagnosis was based on detailed comparison of eggs in human stool with intrauterine ones of several heterophyids and *C. sinensis* recovered from dogs experimentally infected with fish intermediate hosts. In Korea, 8 suspected human cases revealing *P. summa* eggs were proved by recovery of many adult flukes after treatment (Seo *et al.*, 1981). They stated that the eggs in stools were easily distin-

guished from *C. sinensis* or *M. yokogawai* by their much smaller size. One among two cases of human *H. h. nocens* infections (Chai *et al.*, 1984) was also identified by adult flukes after finding the eggs during routine stool examination. By careful observation and measurement of heterophyid eggs in fecal examinations, more human cases of these flukes other than *M. yokogawai* are expected to be found in Korea.

SUMMARY

In order to provide some clues for differential diagnosis of trematode infections in fecal examination, the comparative morphology of eggs of 5 kinds of heterophyid flukes (*Metagonimus yokogawai, Heterophyes heterophyes nocens, Heterophyopsis continua, Stellantchasmus falcatus* and *Pygidiopsis summa*) and *Clonorchis sinensis* was studied. The eggs were obtained from distal portion of uteri of worms which were recovered from men after treatment. The characteristic shape and appearance of each kind of eggs were observed in detail under light microscope, and their length and width measured and compared one another.

The results are as follows:

1. Eggs of *C. sinensis* are elongated ovoidal in shape with attenuated anterior end, 25.3～33.2 (28.3 in average) μm long and 14.2～17.4 (15.9) μm wide with length/width ratio of 1.60～2.00 (1.78). They differ from all heterophyid eggs in that they have prominent wrinkling (muskmelon pattern) at their shell surface.

2. *P. summa* eggs are ovoid to pyriform in shape and characterized by the smallest size of all kinds examined, 19.8～22.9 (21.6) μm long and 11.1～13.4 (12.1) μm wide and the ratio 1.63～1.99 (1.78).

3. Eggs of *S. falcatus* are elongated ovoidal and most slender form, 25.3～29.2 (27.2) μm long and 11.1～13.4 (12.5) μm wide with the ratio of 2.00～2.57 (2.17).

4. Eggs of *M. yokogawai* are ellipsoid to elliptical in shape with round both ends, 26.9～31.6 (28.5) μm long and 14.2～18.2 (16.8) μm wide with the ratio of 1.48～2.11 (1.70).

5. *H. continua* eggs are oval in shape, sometimes similar to *M. yokogawai* or *H. h. nocens* eggs, however, the relative breadth is broadest among all kinds, with maximum width at posterior half portion. They are 23.7～27.7 (25.0) μm long, 15.8～18.9 (16.4) μm wide with the ratio of 1.33～1.75 (1.53).

6. Eggs of *H. h. nocens* are ellipsoid to ovoid in shape but sometimes more slender than *M. yokogawai* and have slightly pointed both ends. They are 23.7～29.2 (25.7) μm long, 14.2～15.8 (15.4) μm wide, and the ratio 1.50～2.06 (1.67).

From the results, it is concluded that eggs of 5 kinds of heterophyids and *C. sinensis* can be morphologically differentiated one another, however, careful observation and measurement on sufficient number of eggs are needed.

REFERENCES

Chai, J.Y. (1984) The measurement values of the eggs of *Clonorchis sinensis* experimentally infected to rabbits. (Unpublished data)

Chai, J.Y., Seo, B.S. and Lee, S.H. (1984) Studies on intestinal trematodes in Korea XI. Two cases of human infections by *Heterophyes heterophyes nocens*. *Korean J. Parasit.*, **22**(1):37-42.

Chun, S.K. (1960) A study on some trematodes whose intermediate hosts are brackish water fish (1) The life history of *Heterophyes continus*, the intermediate host of which is *Lateolabrax japonicus*. *Bull. Pusan Fish. Coll.*, **3**(1,2):40-44 (in Korean).

Chun, S.K. (1963) On some trematodes whose intermediate hosts are brackish water fish (II) The life history of *Pygidiopsis summus*, the intermediate host of which is *Mugil cephalus*. *Bull. Pusan Fish. Coll.*, 5(1):1-5 (in Korean).

Ishii, S. (1929) Studies on clonorchiasis in Kwangtung II. On the *Clonorchis* eggs in the feces. *Jikken Igaku Zasshi*, **12**(2):39-59 (in Japanese).

Kagei, N., Oshima, T., Ishikawa, K. and Kihata, M. (1964) Two cases of human infection with *Stellantchasmus falcatus* Onji et Nishio, 1915 (Heterophyidae) in Kochi Prefecture. *Japanese J. Parasit.*, **13** (6):472-478 (in Japanese).

Komiya. Y. (1966) *Clonorchis* and clonorchiasis. *Ad-*

vances in Parasit., 4:53-106, Academic Press Inc. (London) Ltd. (London) Ltd.

Noda, K. (1959) The larval development of *Stellantchasmus falcatus* (Trematoda: Heterophyidae) in the first intermediate host. *J. Parasit.*, 45(6):635-642.

Ochi, S. (1931) Studies on the trematodes whose intermediate hosts are brackish water fishes-On the life cycle of *Pygidiopsis summus. Tokyo Iji Shinshi*, (2, 712):346-353 (in Japanese).

Onji, Y. and Nishio, T. (1916) On the trematodes whose intermediate host is brackish water fishes. *Chiba Igaku Semmon Gakko Zasshi*, 81 & 82:229-249 (in Japanese).

Onji, Y. and Nishio, T. (1924) A monograph of intestinal trematodes. *Chiba Igakkai Zasshi*, 2(3): 113-161 (in Japanese).

Saito, S. (1972) On the differences between *Metagonimus yokogawai* and *Metagonimus takahashii* I. The morphological comparisons. *Japanese J. Parasit.*, 21(6):449-458 (in Japanese).

Seo, B.S., Cho, S.Y. Chai, J.Y. and Hong, S.T. (1980) Studies on intestinal trematodes in Korea II. Identification of the metacercariae of *Heterophyes heterophyes nocens* in mullets of three southern coastal areas. *Seoul J. Med.*, 21(1):30-38.

Seo, B.S., Hong, S.T. and Chai, J.Y. (1981) Studies on intestinal trematodes in Korea III. Natural human infections of *Pygidiopsis summa* and *Heterophyes heterophyes nocens. Seoul J. Med.*, 22(2): 228-235.

Seo, B.S., Lee, S.H., Chai, J.Y. and Hong, S.J. (1984a) Studies on intestinal trematodes in Korea XIII. Two cases of natural human infection by *Heterophyopsis continua* and the status of metacercarial infection in brackish water fishes. *Korean J. Parasit.*, 22(1):51-60.

Seo, B.S., Lee, S.H., Chai, J.Y. and Hong, S.J. (1984b) Studies on intestinal trematodes in Korea XII. Two cases of human infection by *Stellantchasmus falcatus. Korean J. Parasit.*, 22(1):43-50.

Seo, B.S., Lee, S.H., Chai, J.Y. and Hong, S.J. (1983) A case of human infection by *Heterophyopsis continua*, *Stellantchasmus* sp., *Stictodora* sp. and *Heterophyes heterophyes nocens. Korean J. Parasit.*, 21(2):298-299 (Abstract in Korean).

Seo, B.S., Rim, H.J., Lee, S.H., Cho, S.Y., Kwack, C.W., Lee, W.J. and Yeo, T.O. (1971) Two cases of metagonimiasis with special reference on the egg laying capacity in the human host. *Seoul J. Med.*, 12(4):234-241.

Suzuki, N., Kumuzawa, H., Araki, T., Hara, M., Morita, H., Segawa, T., Shiina, T., Yamada, S. and Tsumoto, S. (1982) Occurrence of *Heterophyes heterophyes nocens* Onji et Nishio, 1916 in man in Kochi Prefecture. *Japanese J. Parasit.*, 31(4):271-274 (in Japanese).

Takahashi, S. (1929) On the eggs of *Stellantchasmus falcatus* and *Pygidiopsis summus* found in human stools. *Okayama Igakkai Zasshi*, 41(7):1, 502-1, 513 (in Japanese).

Yamaguti, S. (1939) Studies on helminth fauna of Japan. Part 25. Trematodes of birds, IV. *Japanese J. Zool.*, 8(2):131-210.

Yokogawa, M., Sano, M., Itabashi, T. and Kachi, S. (1965) Studies on the intestinal flukes II. Epidemiological studies on heterophyid trematodes of man in Chiba Prefecture. *Japanese J. Parasit.*, 14 (6):577-585 (in Japanese).

Yokogawa, S. (1912) On a new trematode which takes *Plecoglossus altivelis* as second intermediate host-*Metagonimus yokogawai. Tokyo Igakkai Zasshi*, 7(9):685-709 (in Japanese).

Yumoto, Y. (1936) On the minute structure of the egg-shells of *Clonorchis sinensis* and on its abnormal eggs. *Taiwan Igakkai Zasshi* 35(8):1, 836-1, 846 (In Japanese.

＝國文抄錄＝

韓國의 人體寄生 異形吸蟲類 및 肝吸蟲 蟲卵의 比較形態學的 檢討

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우리나라의 人體寄生 異形吸蟲類(요꼬가와吸蟲, *Heterophyes heterophyes nocens, Stellantchasmus falcatus, Heterophyopsis continua, Pygidiopsis summa*) 및 肝吸蟲 蟲卵의 比較形態學的 特徵을 관찰함으로써 大便檢査에 의한 이들의 診斷에 도움이 되도록 하고자 이 硏究를 실시하였다. 蟲卵은 感染者를 治療하여 얻은 각 蟲體의 子宮말단으로부터 분리한 것을 使用하였고 전체적인 外形 및 形態는 물론 길이, 폭 및 길이/폭의 比를 구하여 種別로 比較檢討하였다.

결과를 要約하면 다음과 같다.

1. 肝吸蟲 蟲卵은 前端部가 오목한 약간 긴 卵圓型이며, 길이 25.3～33.2μm(平均 28.3μm), 폭 14.2～17.4(15.9)μm, 길이/폭의 比가 1.60～2.00(1.78)이었다. 이들은 난각에 주름(wrinkling)이 뚜렷한 점에서 관찰한 모든 異形吸蟲類 蟲卵과 구별되었다.

2. *P. summa*의 蟲卵은 卵圓型 또는 서양배 모양이며 관찰한 蟲卵중 가장 작은 점이 특징이었고, 길이 19.8～22.9(21.6) μm, 폭 11.1～13.4(12.1)μm, 그 比는 1.63～1.99(1.78)이었다.

3. *S. falcatus*의 蟲卵은 長卵圓型이며 가장 길쭉한 形態인 것이 특징이었고, 길이 25.3～29.2(27.2)μm, 폭 11.1～13.4(12.5)μm, 比는 2.00～2.57(2.17)이었다.

4. 요꼬가와吸蟲 蟲卵은 類楕圓型 또는 楕圓型이며 兩端이 둥근 편이었고, 길이 26.9～31.6(28.5)μm, 폭 14.2～18.2(16.8)μm, 比는 1.48～2.11(1.70)이었다.

5. *H. continua* 蟲卵은 卵型이었고 요꼬가와吸蟲卵이나 *H. h. nocens* 蟲卵과 비슷한 경우도 많으나 蟲卵의 길이에 비해서 폭이 가장 크고 최대폭이 蟲卵 後半部에 있는 점이 특징적이었으며, 길이 23.7～27.7(25.0)μm, 폭 15.8～18.9(16.4)μm, 比는 1.33～1.75(1.53)이었다.

6. *H. h. nocens*의 蟲卵은 類楕圓型 또는 卵圓型이나 요꼬가와吸蟲보다는 다소 덜 팽대되어 있고 兩端이 다소 뾰족한 감을 주는 것이 특징이며, 길이 23.7～29.2(25.7)μm, 폭 14.2～15.8(15.4)μm, 比는 1.50～2.06(1.67)이었다.

이상의 結果로 볼 때 5種 異形吸蟲類 및 肝吸蟲 蟲卵은 形態學的으로 서로 감별할 수 있을 것으로 생각되나 많은 數의 蟲卵에 대한 세밀한 관찰과 計測이 要求된다는 것을 알 수 있었다.