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The first discovery of an endemic focus of *Heterophyes nocens* (Heterophyidae) infection in Korea

Jong-Yil Chai*, Hyung-Keun Nam, Jina Kook and Soon-Hyung Lee

Department of Parasitology and Institute of Endemic Diseases, Seoul National University College of Medicine, Seoul 110-799, Korea

Abstract: A highly endemic focus of human infection with *Heterophyes nocens* (Heterophyidae) was discovered from a small coastal village of Shinan-gun, Chollanam-do, for the first time in Korea. Fecal examinations by cellophane thick smear and formalin-ether sedimentation techniques revealed 42.9% heterophyid egg positive rate out of 98 inhabitants examined. It was difficult to confirm the species of heterophyids only by eggs. In order to collect the adult flukes, the egg positive cases were treated with 10 mg/kg single dose of praziquantel and purged with magnesium sulfate, and the adult worms were collected from the diarrheic stools. From each of 18 cooperative patients 1 to 1,124 (total 4,730) *H. nocens* worms were recovered, together with a few to large numbers of heterophyids (*Pygidiopsis summa, Stictodora fuscatum*) and/or gymnophallids (*Gymnophalloides seoi*). It is speculated that *H. nocens* might be widely distributed along the southwestern coastal areas where the brackish water fish such as the mullets or gobies are popularly eaten raw.

Key words: *Heterophyes nocens*, Shinan-gun, epidemiology, prevalence, worm burden, human infection

INTRODUCTION

It is well known that human infections with the flukes of the genus *Heterophyes* are chiefly caused by two species, *H. heterophyes* (v. Siebold, 1852) and *H. nocens* (Onji and Nishio, 1916); the former in Egypt and the Middle East (Taraschewski, 1984) and the latter in the Far East such as Japan and Korea (Yokogawa *et al.*, 1965; Seo *et al.*, 1981a; Chai *et al.*, 1984 & 1985).

In Korea, Seo *et al.* (1980) first confirmed the existence of the life cycle of *H. nocens* in three southern coastal areas (Hadan-dong, Pusan City; Goje Island, Gyongsangnam-do; Yongsanpo, Chollanam-do), by observing the metacercariae encysted in the muscle of mullets, *Mugil cephalus*, and obtaining the adult flukes from experimental animals. Soon after then a case of human infection with *H. nocens* was found from Okku-gun, Chollabuk-do (Seo *et al.*, 1981a). Further cases have been encountered, and so far total 13 cases have been described in the literature (Chai *et al.*, 1984 & 1985; Sohn *et al.*, 1989). However, the cases were found from sporadic areas, and endemic foci of *H. nocens* infection had never been reported. Recently we found out a small coastal village of Shinan-gun, Chollanam-do where human *H. nocens* infection is highly prevalent.

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* Corresponding author

MATERIALS AND METHODS

1. Fecal examination

During 1989-1990, fecal samples were collected from 98 out of a total of 230 inhabitants residing in a small coastal village on Aphae Island, Shinan-gun, Chollanam-do, and were examined by both cellophane thick smear and formalin-ether sedimentation techniques.

2. Worm collection

After fecal examination, the heterophyid egg positive cases were treated orally with 10 mg/kg single dose of praziquantel and purged with 30 g of magnesium sulfate. After 1 hour, the diarrheic stools were collected and washed several times in tap water. The adult worms of *H. nocens* were collected under a stereo-microscope and fixed with 10% formalin under cover slip pressure. They were stained with Semichon's acetocarmine and observed. The number of worms collected from each case was counted to assess the individual worm burden.

RESULTS

The overall egg positive rate of intestinal helminths was 71.4%, *i.e.*, 70 positives among 98 inhabitants examined. Trematodes showed the highest prevalence, 61.2%, which included 42.9% (42 inhabitants) positive rate of heterophyids (mostly *Heterophyes nocens*, as confirmed later by adult flukes), 49.0% (48) of *Gymnophalloides seoi* (for details refer to Lee *et al.*, 1994), 7.1% (7) of *Clonorchis sinensis*, and 1.0% (1) of *Paragonimus westermani*.

The measurement of individual worm burdens of *H. nocens* was completed in 18 heterophyid egg positive cases who agreed with the praziquantel treatment and purgation. The number of adult flukes recovered from 18 patients ranged from 1 to 1,124 specimens by individual, and 4,730 in total, with an average value per infected person of 263(Table 1).

The adult specimens (Fig. 1) of *H. nocens* were morphologically compatible with the descriptions given by Onji and Nishio (1916) and Chai *et al.* (1984 & 1985). The body was dorsoventrally flat, ovoid (Fig. 2), and 0.82-1.02 mm in length and 0.52-0.63 mm in width (10 specimens were measured). The genital sucker was 0.15-0.20 mm in size, armed with 49-63 rodlets on its gonotyl (Fig. 3), and located prominently in close vicinity to the ventral sucker. The rodlets were interrupted ventrally near the anteromedian portion of the genital sucker. Eggs from distal uteri were oval, 0.027-0.031 mm in length and 0.016-0.018 mm in width, dark yellowish, operculated, and containing miracidia. They were similar in shape to those of *C. sinensis* but could be differed by a little more slender form and maximum width near the equatorial portion (Fig. 4).

Table 1. Number of *H. nocens* recovered from each infected case

Patient code	Age & Sex	No. of *H. nocens* recovered
1	65 M	1
2	58 F	4
3	55 F	4
4	56 M	8
5	47 F	12
6	38 F	15
7	58 M	70
8	37 M	86
9	65 M	98
10	49 F	106
11	57 M	155
12	37 M	158
13	33 M	335
14	32 F	504
15	45 M	616
16	51 M	689
17	59 M	745
18	42 M	1,124
Total		4,730*

*Average No. of worms per case: 263.

DISCUSSION

Until present, only 13 sporadic cases of human *H. nocens* infection had been reported in Korea (Seo *et al.*, 1981a; Chai *et al.*, 1984 & 1985; Sohn *et al.*, 1989). It is quite unlikely, however, that human infections with *H. nocens* occurred so rarely in spite of the popularity of eating raw brackish water fish such as the

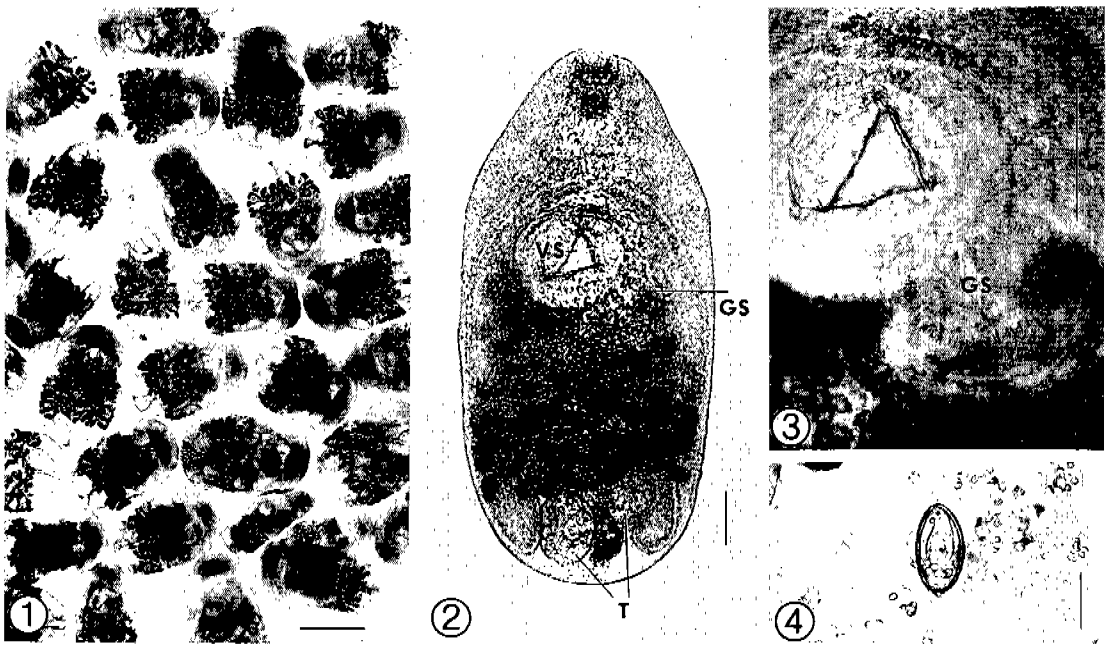

Fig. 1. *Heterophyes nocens* adult flukes recovered from a patient (code No. 15 of Table 1). Formalin-fixed unstained specimens. Scale bar: 0.5 mm. **Fig. 2.** An adult specimen of *H. nocens* recovered from the same patient showing the oral sucker, ventral sucker (VS), genital sucker (GS) and testes (T). Ventral view, fresh preparation. Scale bar: 0.1 mm. **Fig. 3.** Close-up view of the genital sucker (GS), which is armed with 52 chitinous rodlets on its gonotyl. Scale bar: 0.1 mm. **Fig. 4.** An egg of *H. nocens* found in the feces of a patient, showing its ovoid shape with maximum width near the equatorial portion, small operculum, clean shell surface, and containing a miracidium. Scale bar: 0.02 mm.

mullet (*Mugil cephalus*) or goby (*Acanthogobius flavimanus*) among many people in Korea.

Several reasons seem to be responsible for the rare detection of *H. nocens* infections. The eggs of *H. nocens* are very similar in size and shape to those of *Metagonimus yokogawai* and *C. sinensis* (Lee *et al.*, 1984), both species are better known and more widely distributed in Korea. For the above reasons, the eggs of *H. nocens*, if they appeared at times in human stools, might have been misdiagnosed as those of *M. yokogawai* or *C. sinensis* in routine stool examinations. In fact, the exact diagnosis of *H. nocens* infection is hardly possible unless the adult flukes are recovered from the egg positive patients after anthelmintic treatment and purgation. Moreover, *H. nocens* produce much smaller number of eggs compared with *C. sinensis*, so that the infected cases with *H. nocens* can be frequently false negative in fecal examinations (unpublished observation). Because of such inconvenience and difficulty in the diagnosis, there have been no field surveys searching for endemic areas of *H. nocens* infection.

This study first confirmed that human *H. nocens* infection should occur not only sporadically but also in group making an endemic focus in Korea. It was of special interest that the endemic area discovered in this study was a small coastal village of Shinan-gun, very close to Mokpo City, since Mokpo area has long time been suspected as an endemic area of *H. nocens* (Asada, 1934; Seo *et al.*, 1980 & 1981b). Asada (1934) mentioned that heterophyid metacercariae (presumably *H. nocens*) were found by H. Kobayashi in 1925 from the mullets collected at Mokpo, although the literature background can not be traced at present. Later, Seo *et al.* (1980 & 1981b) identified the metacercariae of *H. nocens* encysted in the flesh of the mullets,

M. cephalus, and gobies, *A. flavimanus*, collected from Mokpo area. The source of human infection with *H. nocens* in this area is, therefore, suggested to be the mullets and/or gobies.

From this study it is speculated that the distribution of *H. nocens* infection in Korea might be wider than previously considered. Many seashore villages in southwestern coastal areas where the mullets and gobies are popularly eaten raw might be turned out to be new endemic foci of *H. nocens* infection in the near future. Hence, much attention should be paid in routine fecal examinations on the inhabitants of seashore villages.

There were debates on the taxonomic validity of *H. nocens* (Faust and Nishigori, 1926), because of its morphological similarity to *H. heterophyes*, the type species. But *H. nocens* has a distinct morphological character of having only 50-60 chitinous rodlets on the gonotyl (Chai *et al.*, 1984) whereas *H. heterophyes* has 70-85 rodlets (Chai *et al.*, 1986). The difference in the number of rodlets on the gonotyl has been a unique and consistent feature of each species (Taraschewski, 1984; Chai *et al.*, 1984, 1985 & 1986). Once *H. nocens* was proposed to be called as a subspecies, *H. heterophyes nocens* (Asada, 1934), which we followed for some time (Seo *et al.*, 1980, 1981a & b; Chai *et al.*, 1984 & 1985), but after then we have regarded it as a distinct species, *H. nocens* (Chai *et al.*, 1986; Chai and Lee, 1990).

The clinical symptoms due to *H. nocens* infection are generally known to be mild gastrointestinal troubles (Chai *et al.*, 1985), unless heavily infected. In this study we were told by many of the patients that they experienced repeated episodes of severe gastrointestinal troubles. But as they were co-infected with other kinds of trematodes such as *G. seoi* (Lee *et al.*, 1994), it seems not appropriate to correlate the symptoms solely with *H. nocens* infection. To elucidate the clinicopathological characteristics of human *H. nocens* infection further studies are recommended.

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=국문초록=

유해이형흡충(*Heterophyes nocens*)의 우리 나라 첫 유행지 발견 보고

서울대학교 의과대학 기생충학교실 및 풍토병연구소

채종일, 남형근, 국진아, 이순형

전라남도 신안군 도서지역의 한 작은 해안 마을이 유해이형흡충(*Heterophyes nocens*)의 농후한 인체 감염 유행지임이 우리 나라에서 최초로 확인되었다. 1989년부터 1990년에 걸쳐 마을 주민 230명 중 98명의 대변을 수집하여 셀로판후층도말법 및 포르말린-에테르 집란법을 병행하여 검사한 바 이형흡충류(heterophyids) 충란이 42명(42.9%)에서 검출되었다. 그러나 충란만으로는 이형흡충류의 종(species)을 진단할 수 없어 충란 양성자들에 대해 praziquantel 10 mg/kg과 하제를 투여한 후 설사변으로부터 성충을 회수하였다. 충란 양성자 42명 중 프라지콴텔 및 하제 투여에 협력한 18명 전원으로부터 충체 회수를 완료할 수 있었고, 유해이형흡충 충체 1-1,124마리(총 4,730마리)를 수집할 수 있었다. 감염자들은 대부분 다른 이형흡충류(*Pygidiopsis summa, Stictodora fuscatum* 등) 및 큰입흡충류(gymnophallid) 특히 *Gymnophalloides seoi*에 중복 감염되어 있었다. 이번 연구 결과로 미루어 보아 유해이형흡충은 중간숙주인 숭어, 문절망둑 등을 즐겨 생식하고 있는 우리 나라 남해안 및 서해안의 해안 마을에 널리 분포하고 있을 것으로 추측되었다.

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