

# Four Human Cases of *Acanthotrema felis* (Digenea: Heterophyidae) Infection in Korea

Jong-Yil Chai<sup>1</sup>, Jae-Lip Kim<sup>1</sup>, Min Seo<sup>2,\*</sup>

<sup>1</sup>Department of Parasitology and Tropical Medicine, Seoul National University College of Medicine, Seoul 110-799, Korea;

<sup>2</sup>Department of Parasitology, College of Medicine, Dankook University, Cheonan 330-714, Korea

**Abstract:** *Acanthotrema felis* is an intestinal trematode of cats originally reported from the Republic of Korea. Only 1 human case infected with a single adult worm has been previously recorded. In the present study, we report 4 human cases infected with a total of 10 worms recovered after anthelmintic treatment and purging. All 4 patients reside in coastal areas of Jeollanam-do, Korea, and have consumed brackish water fish including the gobies, *Acanthogobius flavimanus*. The worms averaged 0.47 mm in length and 0.27 mm in width, and had 3 sclerites on the ventrogenital sac; 1 was short and thumb-like, another was long and blunt-ended, and the 3rd was long and broad-tipped. They were identified as *A. felis* Sohn, Han, & Chai, 2003. Surveys on coastal areas to detect further human cases infected with *A. felis* are required.

**Key words:** *Acanthotrema felis*, human infection, intestinal fluke, heterophyid fluke

## INTRODUCTION

The genus *Acanthotrema* (Digenea: Heterophyidae) are intestinal parasites of fish-eating birds and mammals [1]. *Acanthotrema acanthotrema*, the type species, was originally described from a bird (*Sterna maxima*) in 1928 in Brazil [2], and other species were subsequently documented. Currently, 8 species are included in this genus; *A. acanthotrema*, *A. armata*, *A. cursitans*, *A. felis*, *A. hancocki*, *A. martini*, *A. tanayensis*, and *A. tridactyla* [1]. The newest species is *A. felis*, which was described in 2003 from the small intestine of stray cats in the Republic of Korea [1]. Various brackish water fish have been reported to be the second intermediate host for *Acanthotrema* species including the mud sucker *Gillichthys mirabilis* and the Southern California killifish for *A. hancocki* [3] and the goby *Acanthogobius flavimanus* for *A. felis* [4].

The geographical locality of *Acanthotrema* spp. is wide. For example, *A. acanthotrema* has been reported from Brazil [2], *A. hancocki*, *A. martini*, and *A. cursitans* from the United States [3,5,6], *A. tridactyla* from Egypt [7] and Kuwait [8], *A. armata*

from Spain [2], *A. tanayensis* from the Philippines [9], and *A. felis* from Korea [1]. The definitive hosts for *A. acanthotrema*, *A. armata*, *A. hancocki*, and *A. martini* are birds, including sea gulls, and those of *A. felis*, *A. cursitans*, and *A. tanayensis* are mammals, particularly cats [1]. *A. tridactyla* can experimentally infect kittens [8] and chicks [7].

Human infections have never been reported in *Acanthotrema* spp., with the exception of *A. felis* [10]. A 70-year-old man residing in Muan-gun, Korea, expelled a single adult worm of *A. felis* after praziquantel treatment, together with 148 *Heterophyes nocens*, 65 *Gymnophalloides seoi*, 30 *Stictodora fuscata*, 1 *Stictodora lari*, and 1 *Stellantchasmus falcatus* [10]. We describe here 4 additional human cases naturally infected with *A. felis* in southern coastal areas of Korea.

## CASE RECORD

During surveys of human intestinal flukes in Shinan-gun (1990), Muan-gun (1995), and Yeongam-gun (2003), Jeollanam-do, Korea, small trematode egg (STE) positive cases in Kato-Katz fecal smears were subjected to adult fluke collection after anthelmintic treatment and purging. Briefly, praziquantel at a dose of 10-15 mg/kg was orally administered and an hour later the patient was given 30 g of magnesium sulfate. All the diarrhetic stools were collected from each case for 4-5 hr and examined under a stereomicroscope. The fluke specimens, if

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\*Corresponding author (bbbenji@naver.com)

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positive, were morphologically examined using a light microscope. Informed consent was obtained from each patient regarding the adult worm recovery.

Ten specimens of *A. felis* were recovered from 4 patients (1-7 per person, average 2.5 worms) (Table 1). All 4 patients were commonly infected with other heterophyid flukes including *H. nocens*, *Pygidiopsis summa*, *S. fuscata*, and *Heterophyopsis continua*. The number of specimens of the aforementioned fluke species was much higher than that of *A. felis* (Table 1). The patients were suffering from vague abdominal discomfort and indigestion, sometimes accompanied by frequent stool, lethargy, and anorexia. However, it was considered that these symptoms were not necessarily due to *A. felis* infection. The patients had habitually eaten raw flesh of brackish water fish, such as the mullet and goby.

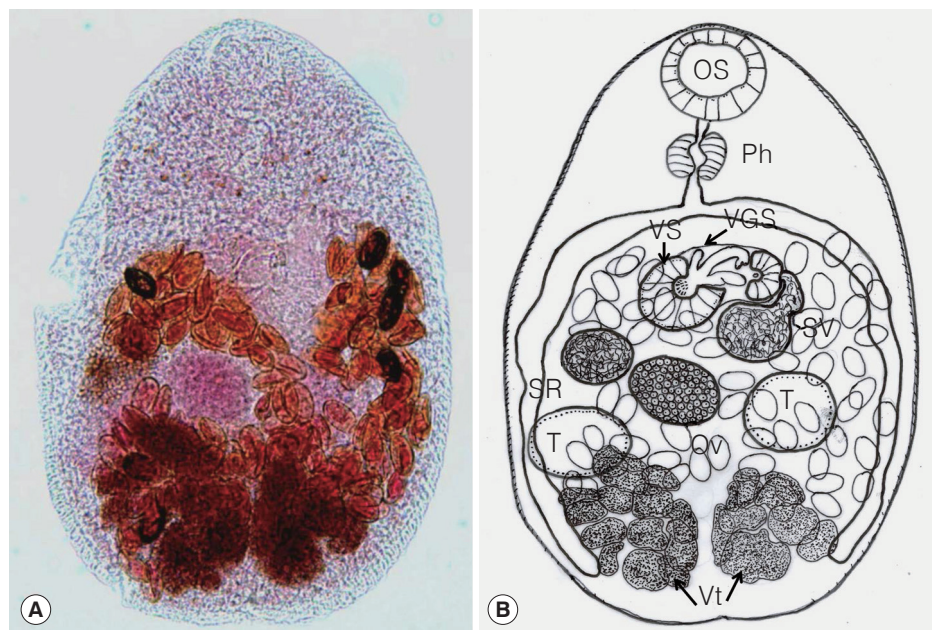
#### Brief description of worms

The morphological characteristics and measurements ( $\mu\text{m}$ ) of the recovered *A. felis* adults are as follows (Table 2). The worms were pear-shaped and were covered with fine tegumental spines, except near the posterior extremity (Fig. 1A, B). Their average body size was 472 in length (range, 405-510) and 269 (230-300) in width. These dimensions were slightly smaller than previously described [1]. The ventral sucker was embedded in the ventrogenital sac which had a distinct membranous covering. The ventrogenital sac was located in the median line, usually at the anterior end of the middle third of the body. Inside the ventrogenital sac, 3 sclerites were observed; 1 was short and thumb-like, 1 was long and blunt-ended, and 1 was long and broadly tipped (Fig. 1). In some specimens, minute spines were seen at the base of the sclerite complex. The gonotyl was U-shaped, unspined, located right to the

**Table 1.** *Acanthotrema felis* and other trematode specimens recovered from the patients

Patient code	Age/sex	Residence	Date	No. of <i>A. felis</i> specimens recovered	Other flukes recovered (no. of specimens)
A	36/M	Shinan-gun	Feb. 1990	7	<i>H. nocens</i> (86), <i>P. summa</i> (33), <i>S. fuscata</i> (5), <i>H. continua</i> (1)
B	56/M	Shinan-gun	Feb. 1990	1	<i>H. nocens</i> (155), <i>P. summa</i> (16), <i>S. fuscata</i> (14)
C	50/M	Muan-gun	Jan. 1995	1	<i>H. nocens</i> (81), <i>P. summa</i> (70), <i>S. fuscata</i> (34)
D	54/M	Yeongam-gun	Nov. 2003	1	<i>H. nocens</i> (146), <i>S. fuscata</i> (9)

*H. nocens*, *Heterophyes nocens*; *P. summa*, *Pygidiopsis summa*; *S. fuscata*, *Stictodora fuscata*; *H. continua*, *Heterophyopsis continua*.



**Fig. 1.** (A) An adult fluke of *Acanthotrema felis* recovered from a patient. Acetocarmine stained. Bar = 45  $\mu\text{m}$ . (B) Line drawing of the worm in Fig. 1A showing its internal organs. The same magnification as Fig. 1A. OS, oral sucker; Ph, pharynx; VS, ventral sucker; VGS, ventrogenital sac; SV, seminal vesicle; SR, seminal receptacle; Ov, ovary; T, testis; Vt, vitellaria.

**Table 2.** Measurements ( $\mu\text{m}$ ) of *Acanthotrema felis* specimens compared to those of the original description

Organ	The present specimens	Sohn et al. (2003)
Body length $\times$ width	472 $\times$ 269	495 $\times$ 263
Oral sucker	58 $\times$ 59	49 $\times$ 58
Pharynx	41 $\times$ 37	43 $\times$ 39
Ventral sucker	50 $\times$ 41	90 $\times$ 58
Testis (right)	88 $\times$ 43	68 $\times$ 50
Testis (left)	83 $\times$ 50	67 $\times$ 48
Sclerite 1	27	
Sclerite 2	38	
Sclerite 3	37	
Egg	26 $\times$ 16	27 $\times$ 15

sclerite complex, and was included in the ventrogenital sac. The ovary was spherical, submedian, and posterolateral to the ventrogenital sac. The seminal receptacle, anterolateral to the ovary, was barely observed. Two testes were ovoid, posterolateral to the ovary, and a little obliquely side-by-side, and were located at the posterior half of the body. The bipartite seminal vesicle was connected to the genital sinus and then to the genital opening in the ventrogenital sac. Vitellaria distributed from the post-testicular level to the posterior extremity, forming 2 large groups of follicles. The uterus formed a transverse loop immediately in front of the ovary, and nearly filled up the posterior half of the body. Eggs elongate oval and light brown. Specimens have been deposited in the Seoul National University Parasite Collection (SNUIPC nos. 14011-14020).

## DISCUSSION

Since the first discovery of *A. felis* in Korea, its presence has been documented several times in the country. Adult flukes were reported from feral cats caught near Pusan [1] and Shinan-gun [11] and from a human in Muan-gun [10]. The present study adds Shinan-gun and Yeongam-gun as new localities for human infections. Metacercariae of *A. felis* were discovered in 7 (35.0%) of 20 *A. flavimanus* in Haenam-gun [4], and in 31 (91.2%) of 34 *A. flavimanus* in Muan-gun [12], with the total number of metacercariae being 116 (17 per fish) and 7,292 (235 per fish), respectively.

Among the 8 species of *Acanthotrema*, only *A. felis* is so far known to distribute in Korea [1], and is the only species infecting humans around the world, based on a previous report [10] and the present study. However, humans seem to be a less susceptible host than birds or mammals, and the pathogenicity of *Acanthotrema* worms to humans is unknown. In the 5 known

human cases, the number of worms recovered per individual was usually 1 with the present exception of 1 patient who expelled 7 worms. This strongly suggests that the human cases may be accidental infections. This low number of infected worms probably would not cause any harmful effect to humans. Humans may have innate resistance against this fluke, although this issue needs further clarification.

*A. felis* is morphologically close to other heterophyids such as *Stictodora* spp. However, *Acanthotrema* has fewer than 12 spines or sclerotizations, and *Stictodora* has more than 12 spines on the ventral sucker or ventrogenital sac [13]. It was not difficult to assign our specimens to *Acanthotrema* because they typically had 3 sclerotizations in the ventrogenital sac [1]. Other morphological characters included a submedian ovary, a bipartite seminal vesicle, a short prepharynx, absence of spines on the gonotyl, and the presence of 3 sclerites on the ventrogenital sac. *A. tanayensis* has 4 sclerites which are unarmed [9] and the sclerites of *A. acanthotrema* consist of 2 armed pieces and a third unarmed piece [2]. *A. tridactyla* has 3 sclerites having minute spines on the tip [7]. *A. armata* has 2 armed sclerites [2], and *A. cursitans* has 2 unarmed, branched sclerites [6]. *A. hancocki* and *A. martini* have 1 U-shaped sclerite [3,5]. The present specimens displayed 3 sclerites with spines on the tip, differing from *A. acanthotrema* and *A. tridactyla*, which have 2-3 sclerites with minute spines on the tip. The shape of the sclerites in our specimens was slightly different from that in the original report of this species [1]. The sclerites in the original report consisted of 1 short, thumb-like piece and 2 long and pointed ones [1]. However, in our specimens, the sclerites consisted of 1 short and thumb-like piece, 1 long and broadly tipped piece, and 1 long and blunt-ended piece. We regard this as an intraspecific variation and identify our specimens as *A. felis*.

The present study is the second report on human *A. felis* infection following the report of Cho et al. [10]. This fluke should be included among the list of human-infecting food-borne intestinal flukes in Korea [14] and Asia [15]. Further studies are required to clarify the geographical distribution and host-parasite relationships of *A. felis* infection.

## CONFLICT OF INTEREST

We have no conflict of interest related to this study.

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