[Jpn. J. Parasitol., Vol. 37, No. 1, 29–35, February, 1988]

The First Human Case Infected with *Diphyllobothrium hians* (Diesing, 1850)

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(Received for publication; September 26, 1987)

Abstract

A cestode discharged from a 29-year-old seaman treated with bithionol was morphologically investigated, and it was identified as *Diphyllobothrium hians* (Diesing, 1850) according to Markowski's description.

This is the first human case infected with the species, which was originally found in the Mediterranean monk seal and later in other seal species.

The worm was given a new Japanese name, "Azarashi retto jochu", which means a seal's diphyllobothriid tapeworm.

Key words: Cestoda, *Diphyllobothrium hians*, human infection, marine diphyllobothriids, tapeworm

Introduction

During the course of reexamination of the so-called broad tapeworm from humans in Japan, Kamo *et al.* (1972) anticipated the occurrence of human tapeworm infections caused by some marine species of *Diphyllobothrium*.

Most Japanese people commonly eat raw or insufficiently cooked fish, and are open to a risk of infection with parasites which may be harboured in such fish.

As was expected human infection with marine diphyllobothriids has actually been demonstrated since then. Namely, "Koga-Okamura type" tapeworm by Kamo *et al.* (1977), Hasegawa *et al.* (1984) and Kagei *et al.* (1987); *D. yonagoense* by Yamane *et al.* (1981), *D. cameroni* by Kamo *et al.* (1981); *D. pacificum* by Kamo *et al.* (1982) and Makiya *et al.* (1987).

Kamo *et al.* (1979), moreover, reported three distinct species belonging to this genus from seamen living in Kyushu, but they were not able to be identified at that time. Two of them were reported as unknown species later by Kamo *et al.* (1986). The third has been identified as *D. hians* (Diesing, 1850) in this investigation, and the morphological features are redescribed in this communication. This infection is thought to be the first human case.

Materials and Methods

A contracted strobila has been preserved in 10% formalin. Portions of the strobila were stained with Semichon's acetic carmine. Some mature or gravid segments were sectioned serially in sagittal and transversal planes, and stained by the modified trichrome staining method. The scolex and eggs were fixed with 1% osmium tetroxide in 0.1 M phosphate buffer, and dehydrated through a graded series of ethanol. After drying in a critical point drying apparatus and coated with gold, they were observed under JEOL-U3 scanning electron microscope (SEM).

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Case report

A 29-year-old seaman, T. S., had been suffered from gastric ulceration since March, 1972. He complained frequently of a refractory epigastric pain, and was admitted to the hospital for accurate examination in August, 1973. Before admission to the hospital he engaged in pelagic fishery for 6 months, making a voyage from the North Sea to the southern waters off Africa. During the navigation various kinds of raw fishes were frequently served at meals.

Blood and chemical examinations and urinalysis revealed no abnormality, but a stool examination showed occult blood and ova of a diphyllobothriid cestode.

On physical examination ulceration was noted on the lesser curvature of the stomach. Before the operation the patient was orally administered bithionol, 40 mg/kg, followed by the laxative (magnesium sulfate) 2 hrs later, and expelled a worm about 70 cm long. Later two-thirds of the pyrolic side of the stomach was resected. The postoperative course was uneventful, and he was discharged.

Description of the worm

(All measurements given are in millimeters)

Contracted specimen with the scolex (body lacking terminal segments 450 in length, 4 in maximum width, 2 in maximum thickness) is identified as *Diphyllobothrium hians* (Diesing, 1850).

Diagnosis: Strobila muscular, with parallel and slightly serrate margins; composed of as many as 800 segments. Maximum width attained near terminal one-fourth of strobia. Segments wider than long, with relative length increasing posteriad. Length/width ratio of pregravid segments about 1:10; of posterior gravid segments about 1:7 (Figs. 1 and 4). Excretory system including longitudinal and transverse ducts in parenchyma and interconnected ducts in cortical region. Nerve trunks are about 0.125 x 0.075 in parenchyma of transverse section. Innermost layer of longitudinal muscle fibers strongly developed, as much as 0.45 thick; adjacent layer of transverse muscles about 0.02 thick (Figs. 8 and 9). Calcareous corpuscles abundant. Lanceolate scolex, with bothria extending full length, 1.9

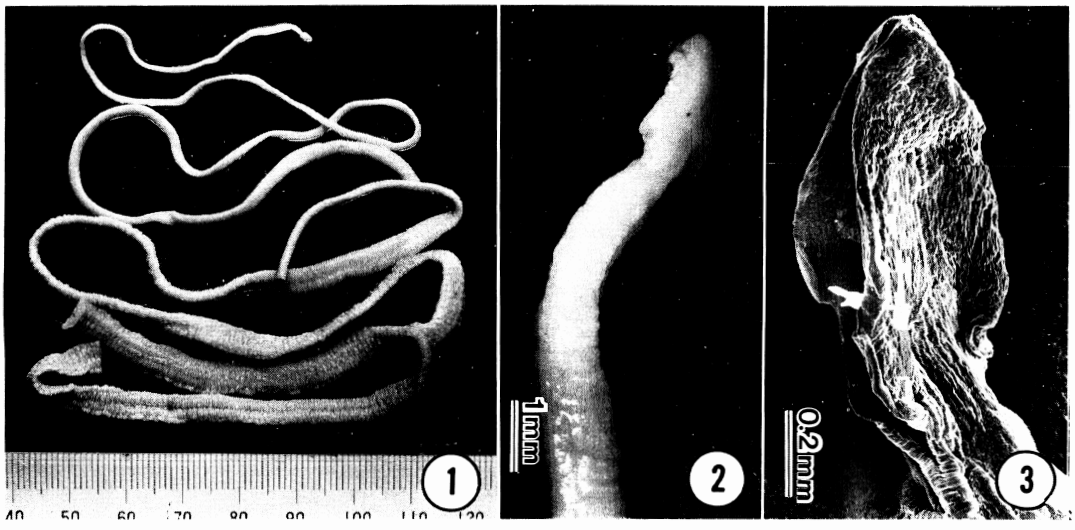
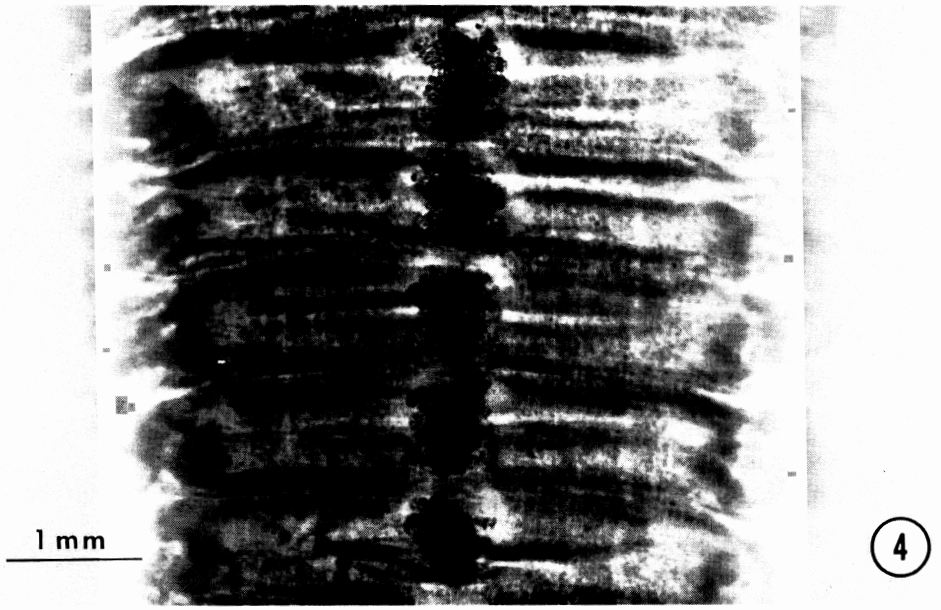


Fig. 1. Whole body.
Fig. 2. Scolex and immature segments.
Fig. 3. SEM micrograph of scolex.

long x 1.2 wide in lateral view (Figs. 2 and 3). Neck indistinct. Genital pore visible within about 100 posterior to scolex, situated ventrally on midline near anterior margin of segment, covered sometimes by velum of preceding segment. Genital atrium lined by rounded papillae. Cirrus sac pyriform, with somewhat undulating margins, 0.473-0.494 long x 0.206-0.267 in diameter (Figs. 6 and 7).

Cirrus sac opening anteriorly into genital



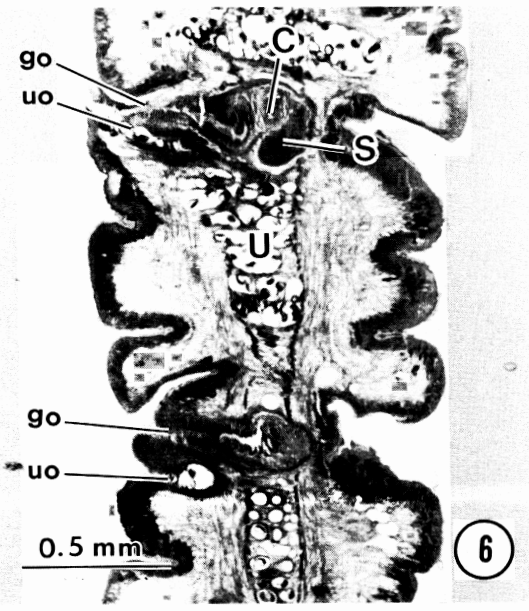
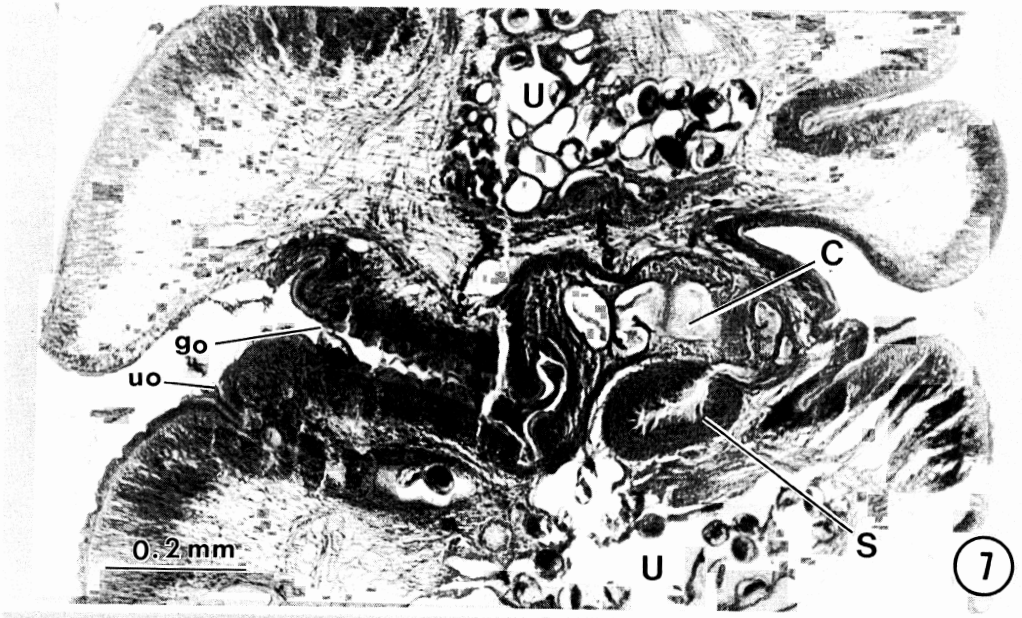


Fig. 4. Whole mount of gravid segments.
Fig. 5. Uterine fields.
Fig. 6. Sagittal section through genital organs.
C: cirrus sac, go: genital pore, S: seminal vesicle, U: uterus, uo: uterine pore.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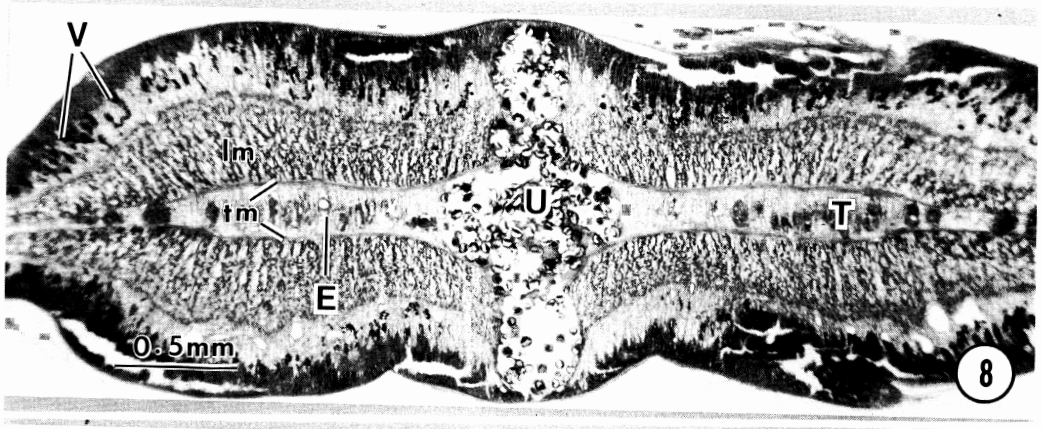
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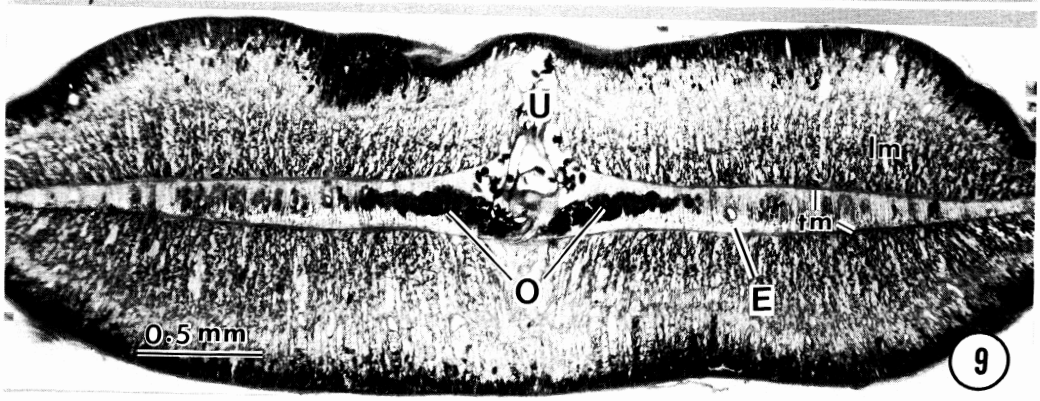
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atrium. Seminal vesicle elongate, 0.175-0.206 in dorsoventral dimension by 0.123 in diameter, with wall of 0.025 thick, situated adjacent and parallel to cirrus sac posteriorly, and connected with latter by short duct about 0.02 in diameter (Figs. 6 and 7). Subspherical testes numerous, 0.113-0.134 in greatest diameter, arranged in a single layer in lateral fields (Fig. 8). Vagina running anteriad then turning ventrad along posterior surface of cirrus sac, with sphincter-like modification of walls in its terminal part near opening. Bilobed ovary situated transversely near posterior margin of segment.

Vitelline follicles elongate and diffuse, forming two lateral fields (Figs. 8 and 9). Gravid uterus forming compact loops extending through the length of segment from posterior margin to level of anterior edge of genital atrium (Figs. 4 and 5). Uterus opening through uterine pore posterior to genital pore, usually to right or left of midline (Figs. 6 and 7). Terminal portion of uterus thick walled, with valve-like structure near orifice. Eggs ellipsoidal to subspherical with or without apical knob, averaging 45 ± 2 x 35 ± 1 μm. Eggshell surface marked by mostly oval, densely distributed pits of 0.2-0.4 μm in longer diameter (Figs. 10-12).

Discussion

Our specimen is identical in almost all morphological details with the description of *Diphyllobothrium hians* (Diesing, 1850) by Markowski (1952), and also with Andersen's (1987) revised description of the same material that Markowski (1952) examined. On the other hand, our specimen is somewhat different from *D. hians* described by Rausch (1969), which has the tiny body with the small rounded scolex, from the Hawaiian monk seal *(Monachus schauinslandi).* Andersen (1987) examined about 50 or more specimens from Hawaiian monk seal collected from the same locality as Rausch collected, and distinguished it from the original and Markowski's (1952) *D. hians* (Diesing, 1850), proposing a new species: *D. rauschi.* Therefore, our specimen can be identified as *Diphyllobothrium hians* sensu stricto.

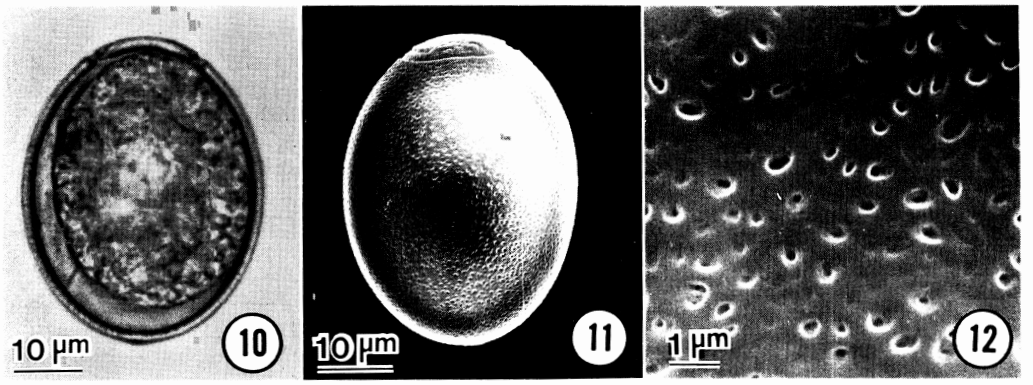

Fig. 10. Egg.
Fig. 11. SEM micrograph of egg.
Fig. 12. SEM micrograph of eggshell surface.

Fig. 7. Sagittal section, showing relative position between cirrus sac and seminal vesicle.
C: cirrus sac, go: genital pore, S: seminal vesicle, U: uterus, uo: uterine pore.

Fig. 8. Transverse section, showing ventral and dorsal extension of uterine loops.
E: excretory canal, lm: longitudinal muscle layer, T: testis, tm: transverse muscle layer, U: uterus, V: vitelline follicle

Fig. 9. Transverse section through level of ovary.
E: excretory canal, lm: longitudinal muscle layer, O: ovary, tm: transverse muscle layer, U: uterus.

According to Markowski (1952) and Andersen (1987), this species was originally described by Diesing (1850) from the Mediterranean monk seal, *Monachus monachus*. Rausch (1969) mentioned that *Phoca hispida* and *P. barbata* were also recorded as the host seals by Diesing (1850). Markowski (1952) reported this species from a seal (probably common seal), *Monachus monachus, Phoca vitulina,* and *Monachus schauinslandi.* These seals are distributed in rather restrictive range or somewhat wide range *(Phoca vitulina)* of the Northern Hemisphere, and not distributed in the Southern Hemisphere. It is most probable that the infection occurred during the voyage of the North Sea, but it does not necessarily mean to neglect the possibility of infection in his home. Because he used to eat fishes in raw or undercooked conditions in his daily life.

This is the first human case infected with *D. hians.* Several marine species of the genus *Diphyllobothrium* have been recorded so far from humans as follows: *D. cordatum* (Leuckart, 1863) from Greenland by Leuckart (1863); *D. alascense* Rausch and Williamson, 1958 from Alaska by Rausch and Williamson (1958), *D. lanceolatum* (Krabbe, 1865) from Alaska by Rausch and Hilliard (1970); *D. pacificum* (Nybelin, 1931) from Peru by Baer *et al.* (1967), from Chile by Atias and Cattan (1976), and Sagua *et al.* (1976), from Japan by Kamo *et al.* (1982), and Makiya *et al.* (1987); *D. yonagoense* Yamane *et al.,* 1981 from Japan, *D. cameroni* Rausch, 1969 from Japan by Kamo *et al.* (1981). Besides the above-mentioned species, two undetermined species were reported from Japanese seamen by Kamo *et al.* (1986). Of these *D. cameroni* Rausch, 1969 and the worm No. 1 of two unknown species by Kamo *et al.* (1986) resemble our specimen in the appearance of medium-sized, stout, yellowish-brown, muscular strobila. They resemble our specimen in relative position of the seminal vesicle to the cirrus sac as well. However, *D. cameroni* is different from our specimen in the relative position of the uterine pore. The uterus opens into the wall of the genital atrium in *D. cameroni,* while it opens separate from and posterior to the genital atrium in our specimen. Moreover, the bothrium is diverging at the apex in *D. cameroni,* while no such divergion occur in our specimen. The worm No. 1 by Kamo *et al.* (1986) is different from our specimen in its rather small scolex, more rapid increase of body width attaining larger maximum width, and larger size of the egg.

SEM observations show that the eggshell surface is characterized by oval, densely distributed pits. These characters of pits resemble roughly those on eggshell surface of *D. cameroni,* and were different from those on eggs of *D. pacificum, D. yonagoense* as well as *D. nihonkaiense* Yamane *et al.,* 1986) (Ishii, 1972; Maejima *et al.,* 1983).

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