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Case Report

A case of human diphyllobothriasis in northern Taiwan after eating raw fish fillets

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The consumption of raw fish fillets is increasing in Taiwan. A male Taiwanese aged 30 years presented after passing a flat, white noodle-like worm. Strobila examination showed that most proglottids were wider than they were long, with the genital pore located at the posterior edge of the cirrus. Histological and coprological findings confirmed the diagnosis of *Diphyllobothrium latum*; ova were ellipsoidal with operculate characteristics, and had a small knob in the anti-operculum side. Hematological data, including vitamin B12 levels, were normal, except for a low folate level. The patient was treated with a single dose of praziquantel 600 mg and 196 cm of proglottids were expelled during the 3 days following treatment. Further follow-up was declined. Consumption of raw and undercooked fish (especially salmon) poses a risk of *D. latum* infection.

Key words: Cestoda; Cestode infections; *Diphyllobothrium*; Fishes; Fish products; Taiwan

Introduction

Diphyllobothriasis is a zoonosis acquired by humans and other mammals when they accidentally ingest plerocercoids present in raw, undercooked, and sometimes smoked freshwater fish, including the flesh, roe, liver, or other organs of the infected fish [1]. It has been reported that several species of diphyllobothriid cestodes may infect humans; however, *Diphyllobothrium latum*, *Diphyllobothrium pacificum*, and *Diphyllobothrium nihonkaiense* are the main pathogens of human cases of diphyllobothriasis [2,3].

D. latum is the longest of these parasites, with a length ranging from 4 to 15 m and a width in the range of 10 to 20 mm. Other *Diphyllobothrium* spp. are relatively smaller and rarely more than 1 m long [4]. Up until the 20th century, *D. latum* infection was mainly limited to regions with cold water lakes, such as Europe and North America, because of the common practice of consuming pickled or insufficiently cooked freshwater fish [2,5,6]. This disease has now spread to other temperate and tropical countries, i.e., Brazil, Korea, Malaysia, and Peru [4,7-9].

In Taiwan, the first case of human diphyllobothriasis was recorded in 1964; 2 cases of *D. latum* infection were reported among 141 indigenous Taiwanese living in the mountainous areas [10]. The first autochthonous case of *D. latum* infection in an 8-year-old Taiwanese boy was recently identified in Kaohsiung, southern Taiwan, after a span of 40 years [11]. We report a new autochthonous case of an adult Taiwanese, aged 30-years-old, infected with *D. latum* after eating raw fish fillets in northern Taiwan.

Case Report

A 30-year-old male visited the Division of Gastroenterology at the Taipei Medical University Hospital on 8 September 2006 due to a white flat, noodle-like worm hanging down from his anus after defecation; he had tried to pull the worm out, but it had broken. The patient brought the worm segment to the hospital.

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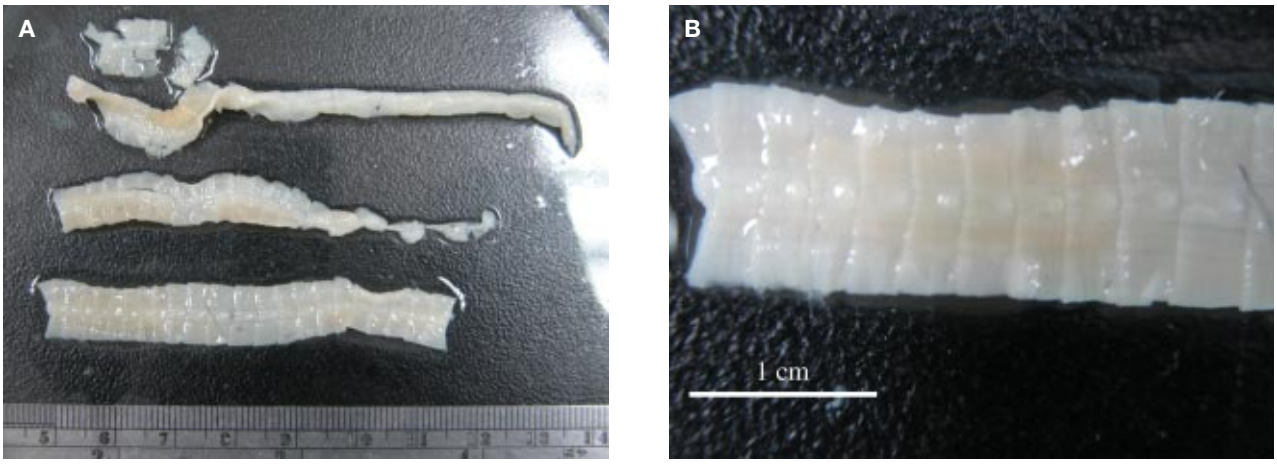

Fig. 1. Strobila of *Diphyllobothrium latum* expelled in the patient's feces. (A) Under low magnification; and (B) under higher magnification (x 400).

The segment was a strobila about 23 cm in length (Fig. 1A); most proglottids were wider than they were long (Fig. 1B). The genital pore of the proglottids expelled from the patient was located at the posterior edge of the cirrus sac (Fig. 2 and Fig. 3A). Histological analysis revealed that the body wall was composed of a tegument, tegumental cells, muscle fibers, and spherical-to-oval laminated calcareous corpuscles (Fig. 3B). The internal uterus contained some round-to-oval eggs with embryo cell (Fig. 3C and Fig. 3D). No more than 5 loops of branches of uterus were seen at each side of the midline (Fig. 3C).

The coprological examination was positive for *D. latum* eggs, which were light yellow in color and ellipsoidal, with operculate characteristics, and had a small knob on the anti-operculum side (Fig. 4). The average size of the 30 eggs examined in the man's stool was $67.9 \pm 4.3 \times 46.9 \pm 2.1$ μm^2 (range, 64.2-74.1 $\times$ 44.5-49.4 μm^2), with a length-width ratio of 1.4:1.0.

Hematological examinations of hemoglobin (14.9 g/dL), hematocrit (46.3%), white blood cells (6860/μL), red blood cells (4.8×10^6/mm^3), platelets (189×10^3/mm^3), mean corpuscular volume (96.5 fL), and mean corpuscular hemoglobin (31.0 pg) were performed. Vitamin B_{12} level was 252 pg/mL, which was within the normal range of 180-914 pg/mL. Folate level was a little low at 4.05 ng/mL (normal range, >5.21 ng/mL). The patient did not complain of any gastro-intestinal discomfort, except for intermittent diarrhea and constipation at times. Occasionally, he also felt weak and tired.

The patient had been consuming "sashimi" (Japanese raw fish, including sailfish, tuna, and salmon flesh) prepared in Japanese restaurants and/or supermarkets, about 3 times a month, for several years. Although the patient had been to China on business travel a number of times, once every 2 months in the preceding year, he claimed to not having eaten any raw fish flesh during his travels in China, as he was aware that eating raw fish flesh in China could be dangerous.

He was treated with 1 dose of praziquantel (600 mg; Synpac-Kingdom Pharmaceutical Co. Ltd., Taiwan) and several proglottids were expelled in stool in the 3 days following treatment. The length of the expelled proglottids was about 196 cm (Fig. 5A and Fig. 5B); however, no scolex was found in the stool specimens. The same dose of praziquantel was given again 1 week later. Further stool examination was not available as the patient maintained

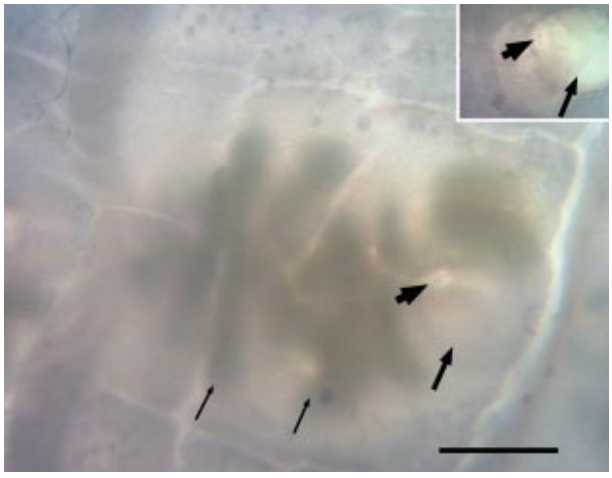

Fig. 2. Gravid proglottid of *Diphyllobothrium latum* from the patient (original magnification x 40). The genital pore (arrowhead), cirrus sac (thick arrow), and 4 uterine loops (thin arrows) in rosette form. Bar = 1 mm. Insert indicates that the genital pore (arrowhead) is located at the posterior edge of the cirrus sac (arrow) under higher magnification (x 400).

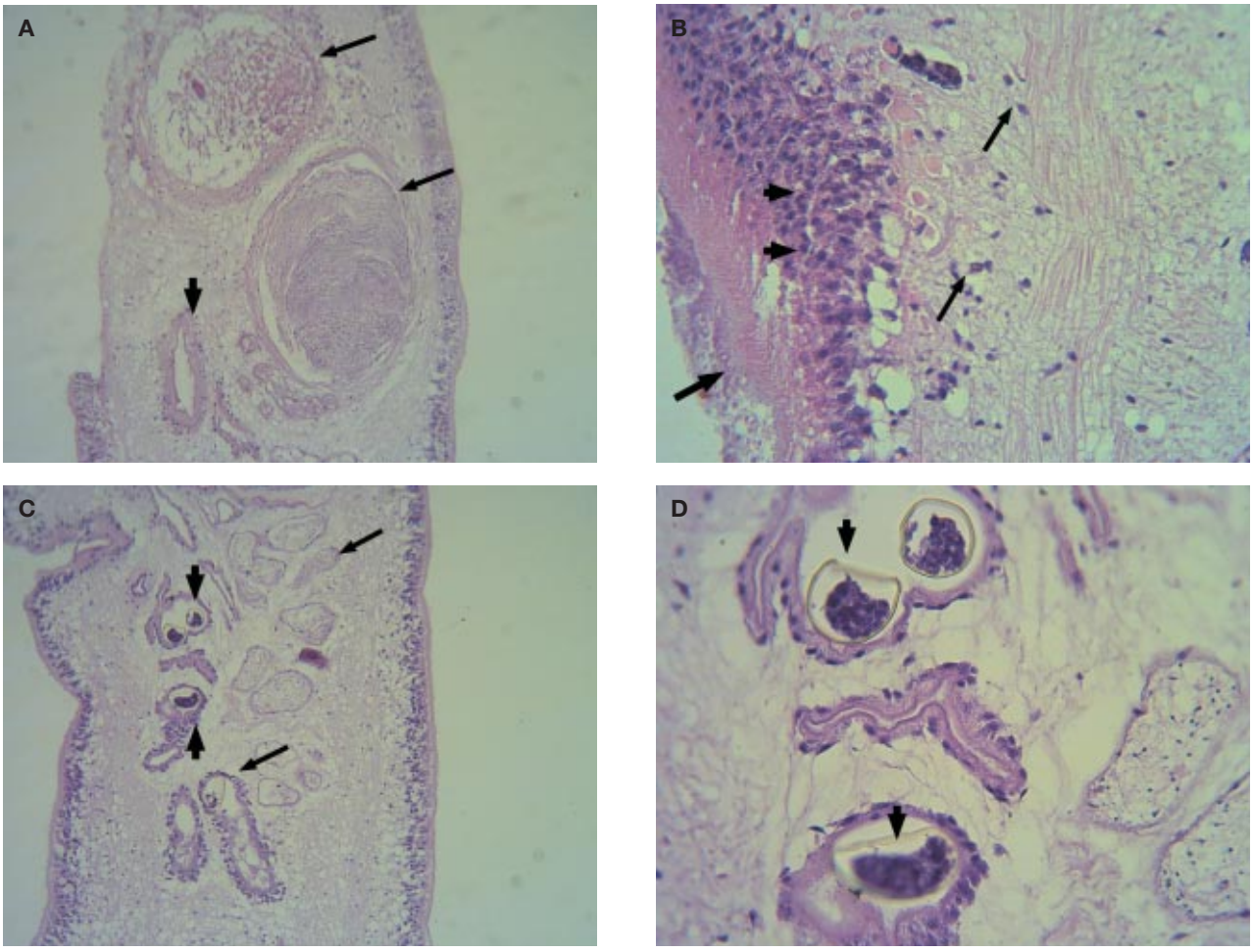

Fig. 3. Histological analysis of *Diphyllobothrium latum*. (A) Transverse section of the gravid proglottid showing genital pore (arrowhead) of the proglottid located at the posterior edge of the cirrus sac (arrows) [hematoxylin and eosin stain, × 100]; (B) body wall is composed of a tegument (thick arrow), tegumental cells (arrowheads), muscle fibers, and spherical-to-oval laminated calcareous corpuscles (thin arrows) [hematoxylin and eosin stain, × 400]; (C) internal uterus (arrows) containing round-to-oval eggs with embryo cell (arrowheads) [hematoxylin and eosin stain, × 100]; and (D) internal uterus containing round-to-oval eggs with embryo cell (hematoxylin and eosin stain, × 400).

that no more proglottids were to be found and showed unwillingness to follow up by telephone.

Discussion

Various species of freshwater or anadromous fishes may be infected with the plerocercoids of *D. latum* [2,12]. Although the main secondary intermediate hosts of *D. latum* in Europe, the USA, and northern Asia are pike, ruffe, and perch, salmonids have long been regarded as the most important hosts of the tapeworm [2,4,6]. Many of the human cases of diphyllobothriasis in Japan have been attributed to *D. nihonkaiense* [13], while those in Europe have been shown to be due to *D. latum* [2]. Although this patient regularly ate sashimi prepared from sailfish, tuna, and salmon flesh in Japanese restaurants and/or supermarkets, it is possible that salmonid fishes imported from Europe were the source of this infection, as ingestion of raw or undercooked marine fish is not known to carry the risk of *D. latum* infection in humans [3-5].

Although finding an operculated egg with a small knob on the anti-operculum side is the most accurate diagnostic method for diphyllobothriasis latum [12], the eggs of most diphyllobothriid parasites have similar characteristics. The size of the *D. pacificum* eggs is the smallest among the 3 most common *Diphyllobothrium* spp., ranging from 40 to 60 μm in length and 36 to 40 μm in width [9]. The egg sizes of *D. nihonkaiense* and *D. latum* are 56.5 to 65.6 × 38.4 to 46.4 μm^2 and 58 to 76 × 40 to 51 μm^2, respectively [7,13]. The eggs in the stool of this patient were bigger than

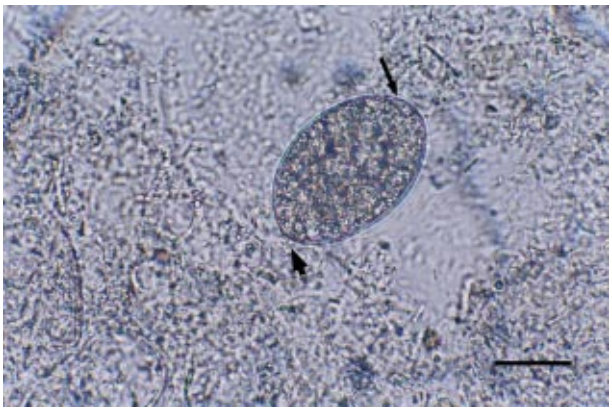

Fig. 4. Egg of *Diphyllobothrium latum* found in the feces of patient (× 400). The eggs are ovoid, with an operculum (arrow) at one side and a small knob at the opposite end (arrowhead), and measure 67.9 ± 4.3 μm in length and 46.9 ± 2.1 μm in width. Bar = 32 μm.

those of *D. pacificum* and more comparable in size to those of *D. latum*. The location of the genital pore was near the posterior edge of the cirrus sac, as seen in *D. latum*. However, the genital pore of *D. nihonkaiense* is also located posteriorly to the center in the cirrus sac [11,13]. In addition, *D. latum* has 3 to 6 uterine loops on each side of the uterus, whereas the uterus of *D. nihonkaiense* has 7 to 8 loops on both of the lateral sides [13]. Thus, at least 3 morphological characteristics of the organism observed, including the location of genital pore in gravid proglottids, uterine loops, and ova isolated from the patient, were more similar to those of *D. latum*.

Diphyllobothriasis latum is typically asymptomatic, and many symptomatic cases are largely unnoticed because of the nonspecific symptoms such as nausea, intestinal discomfort, and diarrhea. However, in some cases, megaloblastic anemia develops as a result of vitamin B_{12} or folate deficiency induced by malabsorption of B_{12} or folate by the host [14]. Our patient presented only nonspecific symptoms of infection, and only complained of weakness and tiredness occasionally. He did not present with megaloblastic anemia. The mild reduction in folate levels was possibly attributable to the short duration between infection and detection of the parasite. Nevertheless, people who have folate deficiency may develop anemia similar to that due to vitamin B_{12} deficiency and fatigue may be seen frequently [14].

Praziquantel is highly effective against intestinal tapeworms in low doses; treatment with 5 to 10 mg/kg yields 99 to 100% cure rates in patients with *D. latum* infection [15]. The reason for administering 2 doses of praziquantel to our patient was that we could not confirm that the whole worm had passed following the first dose.

Although Taiwan is in the subtropical region, recent changes in eating habits, such as a greater consumption of raw and undercooked fish (especially salmon), may lead to the reappearance of *D. latum* infection in humans. Cooking fish to 56°C or higher for longer than 5 min or freezing fish to –18°C for 24 h may kill the plerocercoid larvae and make it safe for consumption [12].

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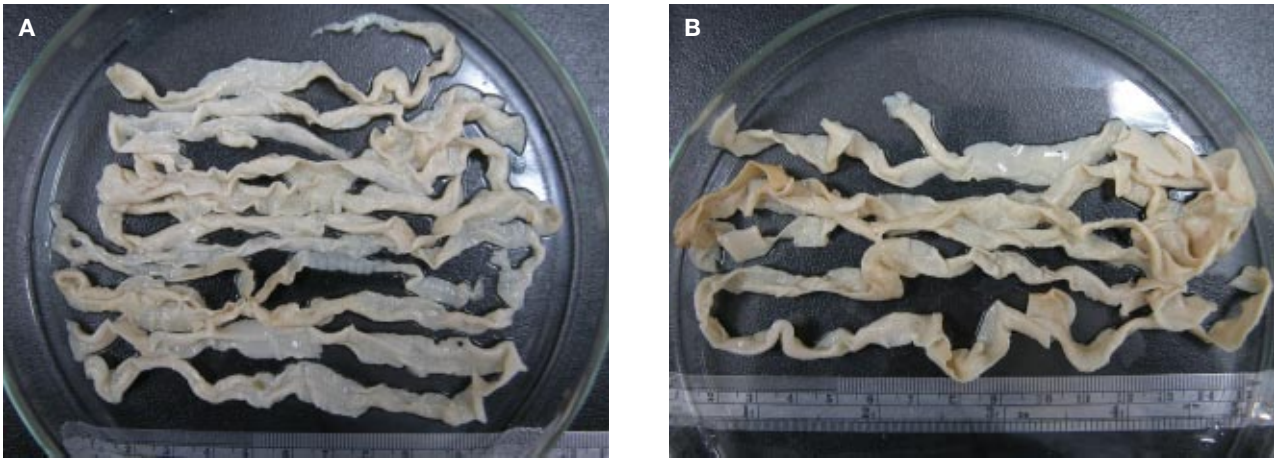

Fig. 5. (A and B) Strobila of *Diphyllobothrium latum* (about 196 cm) expelled in patient's feces following praziquantel treatment.

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