Long Fish Tapeworm in the Intestine:
An *in situ* Observation by Capsule Endoscopy

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**Abstract**

We present the case of a patient who was referred to our hospital after she reported having passed a long, whitish object per rectum. Accordingly, capsule endoscopy was performed using the PillCam® SB video capsule. A tapeworm of the species *Diphyllobothrium nihonkaiense* was detected; it appeared to be freely floating and unfolded in the jejunum and sometimes tangled or irregularly folded in the ileum. The stretching of the strobila by strong peristalsis in the ileum may have resulted in the separation of the caudal portion of the strobila, which descended into the colon and was eventually passed per rectum.

**Key words:** capsule endoscopy, *Diphyllobothrium nihonkaiense*, tapeworm, parasite, small intestine

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**Introduction**

Fish tapeworm infestation is prevalent in Europe and the Far East. *Diphyllobothrium latum* infection, which is common in European countries, is contracted by ingesting raw or undercooked fish, such as perch, char, and pike; *Diphyllobothrium nihonkaiense* infection, common in the Far East, generally occurs because of the ingestion of wild Pacific salmon. Interestingly, the prevalence of *D. nihonkaiense* infection in Japan has been increasing during the past few years. Moreover, several reports from European countries have also discussed clinical cases wherein tapeworm DNA sequencing confirmed *D. nihonkaiense* infection (1). Most patients infected with *D. latum* do not present with any grave symptoms; very few patients have been reported to develop the complication of pernicious (megaloblastic) anemia (2). The commonest complaint is the passing of some white material, which is actually a portion of the tapeworm. If this complaint is disregarded by physicians or tapeworm infestation is misdiagnosed as infestation with other parasites, this rather asymptomatic disease is left untreated for a long period.

Tapeworms of the *D. nihonkaiense* species inhabiting the intestine can measure up to 10 meters in length. In a previous report similar to this one, capsule endoscopy was used to identify the scolex of *D. nihonkaiense* attached to the mucosa of the upper part of the small intestine (3). However, it is unclear how this extremely long tapeworm resides in the small intestine. Here, we report a case of *Diphyllobothriasis* infestation in which almost the entire strobila was observed in situ by a capsule endoscope.

**Case Report**

The patient, a middle-aged Japanese woman, was referred to our hospital for further examination after she reported having passed a long, whitish object per rectum. No particular abnormality was noted on physical and blood examinations. To identify the object, capsule endoscopy was performed using the PillCam® SB video capsule.

The capsule entered the duodenum 11 minutes after its ingestion and reached the ileocecal junction at 5 hours 16 minutes. An immature strobila was first visible at 1 hour 14

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minutes after capsule ingestion (Fig. 1A). The scolex could not be identified. During the movement of the capsule in the distal direction, the tapeworm was sometimes visible and sometimes not: the tapeworm’s genital glands were first visible after 1 hour 22 minutes, and branched uteri were first detected at 1 hour 58 minutes. Thereafter, uterine loops-4 to 5 loops on each side—could be observed (Fig. 1B); this feature is characteristic of *Diphyllobothrium* spp. The strobila in the jejunum appeared to be freely suspended in the intestine, and at some points, it was positioned against the intestinal mucosa and did not appear to be folded. In the ileum, however, the strobila appeared to be sometimes stretched extensively because of peristaltic movements (Fig. 1C), tangled at some portions (Fig. 1D), and irregularly folded at other portions (Fig. 1E). The strobila in the small intestine could be visualized until 5 hours 2 minutes after the capsule ingestion. However, fragments of strobila were again detected in the colon 5 hours 27 minutes after the capsule ingestion and continued to be visualized thereafter (Fig. 1F).

The next day, the patient was administered a single dose of praziquantel (12 mg/kg). A 5.0-meter-long strobila was expelled 7 hours later. The scolex was spatulate, measuring 2.0 mm in length and 0.9 mm in maximum width, followed by a fragile neck and the strobila, which widened posteriorly to a maximum width of 12 mm. DNA sequences of the genes *cox1* and *nad3* from the tapeworm were compatible with those of *D. nihonkaiense*.

**Discussion**

The distribution of *D. nihonkaiense* infection has changed drastically over time, with the infection now being more predominant in urban areas than in rural areas; this shift can be attributed to the rapid expansion of the transport system for fresh and frozen fish to meet the demand for seafood as health food. A recent report on capsule endoscopy revealed that the scolex of *D. nihonkaiense* was attached to the mucosa of the upper portion of the small intestine (3).

The disposable capsule endoscope captures images that are wirelessly transmitted to a data recorder worn by the patient. Although capsule endoscopy does not identify the histopathological changes in the small intestine, it enables the visualization of the gross changes in the small intestine (4). This new, relatively non-invasive, technology has enabled, for the first time, the in vivo direct imaging of the small bowel lumen and mucosa, which has, thus far, been largely impossible. Some case reports have been published on the capsule endoscopy findings in cestode parasite infestation (3, 5). However, the use of the endoscopy method was limited to the confirmation of the existence of the para-
sites in these cases.

To date, there is hardly any information on how the tapeworm manages to accommodate its long body in the small intestine. A possible explanation proposed earlier was that it resides only in the upper half of the small intestine by folding its strobila; this was considered probable because the cestode can absorb large amounts of nutrients only in the duodenum and jejunum. However, the findings of capsule endoscopy in this case clearly showed that the strobila resided almost entirely in the small intestine without notable folding. Tapeworms lack a digestive system and absorb nutrients only from the body surface of each segment. Thus, the gravid proglottids residing in the above-mentioned manner can face a lack of energy resources.

The findings obtained in this case prove for the first time that the fully developed cestode can occupy the small intestine from the initial portion of the jejunum to the end of the ileum in man. Our findings provide direct evidence for the pathological changes occurring in the small intestinal during parasitic infestation. Parts of the tapeworm were visible for at least 74.8% of the capsule’s total transit time in the small intestine, which roughly corresponds to the jejunum to the terminal part of the ileum. In the jejunum, the tapeworm appeared to be freely floating and unfolded, while in the ileum, it was sometimes tangled or irregularly folded. The stretching of the strobila by strong peristalsis in the ileum seemed to contribute to the separation of caudal portion of the strobila, which descended into the colon and was eventually passed in the feces. We assume that the lower part of strobila, which resides in the ileum, can be easily disconnected from the upper part of the strobila by bowel movement, and this disconnected part may naturally descend into the colon. Unlike the case in *Taenia saginata* infection (5), there were no gross pathological changes on the mucosal surface, which is consistent with the rather asymptomatic nature of *Diphyllobothrium* spp. infection.

For the treatment of *D. nihonkaiense* infection, the excetration of the scolex is very important; if it remains in the gut, the tapeworm will grow again. Oral administration of a single dose of praziquantel at 5 to 10 mg/kg was reported to be effective and safe for *D. nihonkaiense* infections, but generally, a single dose of 25 to 50 mg/kg is administered (6-8). Adverse effects of praziquantel are usually mild and do not require treatment, although they may be more frequent and serious in patients with a heavy worm burden. The following are the adverse effects of praziquantel in order of severity: malaise, headache, dizziness, abdominal discomfort with or without nausea, rise in temperature, and, rarely, urticaria (9). Such symptoms can, however, also occur with the infection itself.

Intraluminal gastrografin (used for contrast-enhanced intestinal radiographs) has been reported to be efficacious in the treatment of large cestodes (10). In the first report on the treatment of cestode infection by orally administered gastrografin, the expelled strobila was more than 6 m long with the scolex and was morphologically identical to *D. nihonkaiense* (11). However, this form of therapy may not be the best option because the insertion of the duodenal tube is painful, the therapy is expensive, and fluoroscopic examination is required (12). On the other hand, the advantage of this method is that the complete, living worm with the scolex is expelled, thereby enabling species identification (13).

In conclusion, we described the capsule endoscopy findings in a case of *D. nihonkaiense* infection. This novel procedure facilitates not only the diagnosis of parasitic infestation in the small intestine but also the study of the actual ecology of intestinal parasite. Further reports on the capsule endoscopic findings of *Diphyllobothrium* spp. infection would help clarify the pathogenesis of its complications such as anemia, which occurs only in a limited number of patients.

The authors state that they have no Conflict of Interest (COI).

References