

# Fish tapeworm and sushi

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A variety of parasitic infections might be acquired by ingesting raw or undercooked fin fish (Table 1).<sup>1-3</sup> Fish tapeworm, or *Diphyllobothrium* spp, is acquired by eating raw or undercooked freshwater or anadromous fish (ie, sea fish that spawn in freshwater rivers, such as salmon). Marinated and smoked fish can also transmit the worm.<sup>4</sup> While cases in previously endemic areas have decreased, likely because of improved sewage treatment processes, cases have increased in other parts of the developed world,<sup>5-9</sup> presumably owing to increased consumption of raw fish.<sup>4</sup> The widespread popularity of Japanese sushi (bite-sized pieces of cold cooked rice topped with fish, eggs, or vegetables and wrapped in seaweed) and sashimi (slices of raw fish) is a contributor, but other popular dishes might also be implicated, such as raw salted or marinated fillets (which originate from Baltic and Scandinavian countries), carpaccio (very thin slices of raw fish common in Italy), *tartare maison* (raw salmon) and *poisson du lac façon nordique* (in French-speaking Europe), and ceviche (lightly marinated fish in Latin America).<sup>4</sup>

## Case

A 43-year-old woman presented to an Edmonton, Alta, emergency department with acute onset of diarrhea and vomiting, and was diagnosed with gastroenteritis. The acute illness resolved, but the patient came to the clinic 8 weeks later complaining of unresolved diarrhea. She was otherwise in good health. There was no history of travel. A workup was ordered, including the following: complete blood count; vitamin B12 level; liver function and lipase tests; hepatitis A, B, and C screening; tissue transglutaminase test; stool for occult blood; and stool culture and examination for ova and parasites.

However, the following day, before any of the workup was done, the patient passed a 75-cm flat worm. She took it to a laboratory where it was identified as *Diphyllobothrium latum* species segments. All other tests ordered came back with normal or negative results, except for an indeterminate hepatitis A immunoglobulin G. On review, the patient described herself as a “regular” sushi consumer. She could not recall any other raw fish consumption, and no more detail concerning the type or source of her sushi was obtained. She was treated with 600 mg of praziquantel. Follow-up stool testing for ova and parasites 2 weeks later showed negative results.

## Discussion

The eggs of *Diphyllobothrium* species hatch into embryos (coracidia) after 2 weeks in cool fresh water. These are ingested by copepods (the first intermediate host), where they develop into the first larval stage, or procercooids, over 2 to 3 weeks. When the copepod is eaten by fish, the procercooids migrate into the muscle fibres of the fish where they metamorphose into the second larval stage, or plerocercoids. Raw fish consumption by a definitive host (carnivore mammals such as bears, dogs,

### EDITOR'S KEY POINTS

- Diphyllobothriasis is infection of the small intestine by the broad tapeworm *Diphyllobothrium* spp acquired from eating undercooked or raw fish. With the increasing popularity of sushi and sashimi, it can be expected that diphyllobothriasis will become more common.
- Diphyllobothriasis infections are often asymptomatic and can persist for years.
- Symptoms include fatigue, constipation, diarrhea, vague abdominal discomfort, and less commonly vomiting.
- Check for vitamin B12 deficiency in suspected and proven cases.
- Treatment is a single dose of 10 to 25 mg/kg of praziquantel.

### POINTS DE REPÈRE DU RÉDACTEUR

- La diphyllobothriase est une infection de l'intestin grêle causée par le ténia large *Diphyllobothrium* sp et acquise en mangeant du poisson mal cuit ou cru. Étant donnée la popularité grandissante des sushis et du sashimi, on peut s'attendre à ce que les cas de diphyllobothriase deviennent plus fréquents.
- Les diphyllobothriases sont des infections souvent asymptomatiques et elles peuvent persister pendant des années.
- Parmi les symptômes, on peut mentionner la fatigue, la constipation, la diarrhée, un vague malaise abdominal et, moins souvent, des vomissements.
- Il faut vérifier s'il y a une carence de vitamine B12 chez les cas suspectés et diagnostiqués.
- Le traitement est l'administration d'une seule dose de 10 à 25 mg/kg de praziquantel.

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and humans) allows the plerocercoids to attach to the small-intestine wall. There they develop into the mature tapeworm over 3 to 5 weeks. Mature *Diphyllobothrium* spp can grow from 2 m to 15 m in length, the largest known parasite in humans; can live for many years in the host intestine; and can discharge very large numbers of eggs per day, completing the cycle.<sup>4,8,10</sup>

### Symptoms and investigations

*Diphyllobothrium* infections are often asymptomatic. When symptoms occur, they are often mild and vague, including fatigue, constipation, and poorly defined abdominal discomfort. Laboratory investigations tend to present normal results, but might show low vitamin B12 levels or frank pernicious anemia (if the worm has attached in the proximal small intestine, it can compete for vitamin B12 absorption).<sup>4</sup> Often the first awareness of infection might be passing segments of the tapeworm in the stool,<sup>5-7</sup> as the patient in this report did, whose diarrhea might have been due to an unrelated illness. Diagnosis is made by identification of ova or sometimes worm segments in the stool (Figures 1 and 2).

### Treatment

Treatment is usually 10 to 25 mg/kg of praziquantel given as a single dose.<sup>4</sup> Stool culture for ova should be negative a week after treatment; occasionally a second dose might be needed.<sup>6</sup> While treatment is generally completed in a single dose, segments might continue to be evacuated over a prolonged period, which can be distressing to patients and their families. If vitamin B12 levels are low, they generally return to normal ranges within a period of several months.<sup>4</sup> While praziquantel is not officially indicated for this use in Canada, it is the accepted treatment in the literature. Niclosamide, 2 g as a single dose, is another accepted treatment, but it is not available in Canada.

### Prevention

Prevention can be accomplished on a population level by good sewage treatment plants interrupting the cycle at the point where eggs are discharged back into the water, when humans are the definitive host. This is the likely reason for the decline of diphyllobothriasis in previously endemic areas such as Scandinavia<sup>4</sup> and coastal areas of Japan.<sup>7</sup>

On an individual level, consumers should be aware of the risks of diphyllobothriasis with consuming uncooked

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fish. Sushi and sashimi are now available not just in restaurants, but also in the deli sections of many grocery stores. Marketers should consider affixing labels to the packaging, assuring consumers that proper preparations have been completed to minimize risks of fish tapeworm. Those who prepare fish should be aware that cooking at a temperature of only 55°C for 5 minutes will kill the larvae; freezing to -20°C for 7 days, or flash freezing to -35°C for 15 hours, as long as the flesh is less than 15 cm thick, effectively kills the larvae also.<sup>4,5,7,8</sup> Sushi

and sashimi chefs should use only fish frozen in this way. While these freezing protocols are the standards required by public health regulations, they are not easy for public health inspectors to verify.

### Relevance

With the increasing popularity and availability of sushi in restaurants and grocery stores, one might expect to see an increase in the number of cases of diphyllbothriasis such as this one. Ching described a substantial increase

**Table 1. Parasitic infections acquired by ingesting raw fish**

CATEGORY	GENUS, SPECIES	SOURCES	SYMPTOMS	DIAGNOSIS	TREATMENT
Nematodes	<i>Anisakis simplex</i>	Raw or undercooked fish or squid	Acute (1-2 h after ingestion, maybe up to 14 d): sudden, severe, episodic epigastric distress, sometimes nausea and vomiting  Chronic: diarrhea, urticaria, occasional coughing up of larvae, intestinal pseudo-obstruction	Ultrasound: might show small-bowel dilatation; thread-like gastric filling defects	Spontaneous recovery; occasional endoscopic removal of worms
Trematodes (liver flukes)	<i>Clonorchis sinensis</i>	Korea, China, Taiwan, Vietnam, and Japan; raw or undercooked fish	Acute (within 1 wk of ingestion): fever, chills, tender hepatomegaly  Chronic: asymptomatic; occasional cholangitis or pancreatitis	Stool for ova	Praziquantel
	<i>Echinostoma</i>	Southeast and east Asia; raw or undercooked fish	Gastroenteritis, anemia, headaches, dizziness, stomach pain, diarrhea, anorexia, eosinophilia	Stool for ova	Mebendazole, albendazole, or praziquantel
Trematodes (intestinal flukes)	<i>Metorchis conjunctus</i>	Raw white sucker fish (case report in Quebec) <sup>1</sup>	1-15 d incubation; abdominal pain, fever, diarrhea, headache, nausea	Stool for ova or serology	Praziquantel or spontaneous resolution
	<i>Heterophyes</i> spp	Middle East, Asia; raw, marinated, or undercooked fish	Abdominal pain, diarrhea	Stool for ova	Praziquantel
	<i>Metagonimus</i> spp	Middle East, Asia; raw, marinated, or undercooked fish	Abdominal pain, diarrhea	Stool for ova	Praziquantel
	<i>Nanophyetus salmincola</i>	North America; raw, undercooked, or smoked fish	Diarrhea, abdominal pain, nausea and vomiting, fatigue, weight loss	Stool for ova	Spontaneous resolution or antiparasitic agents
Cestodes	<i>Diphyllbothrium latum</i>	Raw, undercooked, or marinated fish	Abdominal pain, diarrhea, eosinophilia, occasional B12 deficiency	Stool for ova or passage of proglottids	Praziquantel or niclosamide*
Protozoa	<i>Giardia lamblia</i>	North America; home-canned salmon; China, <i>koi pla</i> (ie, fish soup), using uncooked freshwater fish	Nausea, chills, fever, epigastric pain, foul-smelling diarrhea (might be mucous-mixed, bloody)	Trophozoites or cysts in stool	Metronidazole

\*Praziquantel is indicated in Canada for the treatment of *Schistosoma* and some liver flukes, but not specifically for fish tapeworm. It is recognized as a treatment for *Diphyllbothrium* spp elsewhere, as is niclosamide. Niclosamide is not available in Canada. Data from Butt et al,<sup>1</sup> van Voorthuis and Weller,<sup>2</sup> and Eastburn et al.<sup>3</sup>

**Figure 1.** *Diphyllobothrium latum* ova wet mount



Photo credit: D.M. Raymondo MLT CLS(M)

**Figure 2.** *Diphyllobothrium latum* proglottids



Photo credit: D.M. Raymondo MLT CLS(W)

in the number of cases in British Columbia between the 1970s and the early 1980s, attributed to increasing consumption of uncooked salmon.<sup>11</sup> A MEDLINE search using the terms *diphyllobothriasis* and *sushi* revealed a number of case reports from a variety of places around the world, only 3 of which had North American connections. In all cases, raw or undercooked fish were consumed, often salmon species, but sometimes perch, char, or pike.<sup>5</sup> Sushi and sashimi restaurants were specifically implicated in some reports.<sup>7-9</sup> Additional cases are likely occurring but are not being reported in the literature. Primary care physicians should keep the possibility in mind.

### Conclusion

Given the current popularity of sushi and sashimi in North America, and the rarity of case reports of diphyllobothriasis in North American literature, one might speculate that there is generally good compliance with proper freezing of fish for these products. However, in cases of vague abdominal complaints or unexplained low vitamin B12 levels, it might be worth asking patients about types of fish consumed, particularly bearing in mind the popularity of sushi and sashimi, and it might be worth checking the stool for *Diphyllobothrium* ova.



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Dr Craig is a family physician in Edmonton, AB.

#### Competing interests

None declared

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