

discomfort, diarrhea, nausea, and weakness. However, the worm can cause a serious megaloblastic anemia in a small number of cases, virtually all in Finnish people. It was thought originally that toxic products of the worm produced the anemia, but we now know that the large amount of vitamin B₁₂ absorbed by the cestode, in conjunction with some degree of impairment of the patient's normal absorptive mechanism for vitamin B₁₂, is responsible for the disease. Nyberg⁷² reported that an average of 44% of a single oral dose of vitamin B₁₂ labeled with cobalt 60 was absorbed by *D. latum* in otherwise healthy patients, but in patients with tapeworm pernicious anemia 80% to 100% of the dose was absorbed by the cestode. The clinical symptoms of tapeworm pernicious anemia are similar in many respects to "classical" pernicious anemia (caused by a failure in intestinal absorption of vitamin B₁₂), except that expulsion of the worm generally brings a rapid remission of anemia. For reasons that remain unclear, possibly due to improved nutritional level, tapeworm pernicious anemia has not been reported for several decades.⁸⁶

- **Diagnosis and Treatment.** Demonstration of the characteristic eggs or proglottids passed with a stool gives positive diagnosis. In the past a variety of drugs was used against *Diphyllobothrium* spp. and other tapeworms; aspidium oleoresin (extract of male fern), mepacrine, dichlorophen, and even extracts of fresh pumpkin seeds (*Cucurbita* spp.) have anticestodal properties.²⁷ However, the drugs of choice are now niclosamide (Yomesan) and praziquantel.⁸⁶ The mode of action of niclosamide seems to be an inhibition of an inorganic phosphate—ATP exchange reaction associated with the worm's anaerobic electron transport system. We described the action of praziquantel on p. 238.

Other Pseudophyllideans Found in Humans

Several other species of *Diphyllobothrium* have been reported from humans in different parts of the world. These include *D. cordatum*, *D. pacificum*, *D. cameroni*, *D. hians*, and *D. lanceolatum*, parasites of pinnipeds, and *D. ursi* of bears. At least some infections of humans on the West Coast of North America and Hawaii apparently are due to *D. dendriticum*,⁵ but some are likely to be from one or more species from pinnipeds with a marine life cycle. *Diphyllobothrium nihonkaiense* is the dominant species in Japan, although other species occur there.^{2, 64}

Digramma brauni and *Ligula intestinalis* have also been reported from humans, but such occurrences must be rare. *Diplogonoporus grandis* (*D. balaenopterae*) has been reported numerous times from humans in Japan.¹ A parasite of whales, its plerocercoid occurs in marine fish, the mainstay of the Japanese protein diet.

Sparganosis

With the exception of forms with scolex armature, species of plerocercoids found in humans are impossible to distinguish by examining their morphology. When proceroids of some species are ingested accidentally, usually when a person

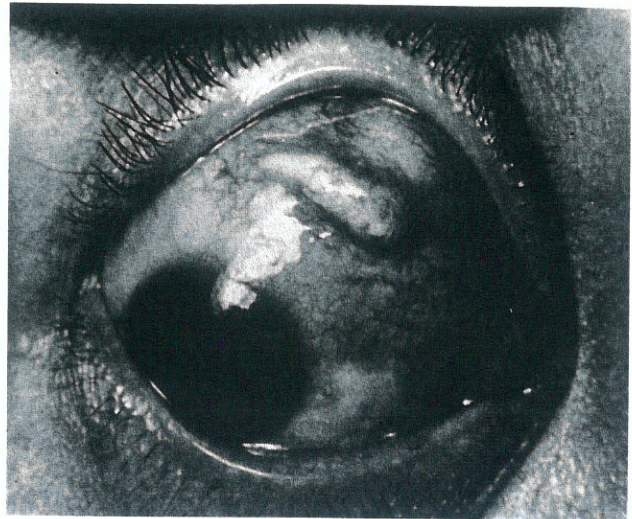


Figure 21.9 Right eye of patient with sparganosis.

Note the protruding mass in the upper conjunctiva.

From L. T. Wang and J. H. Cross, "Human sparganosis on Taiwan. A report of two cases," in *J. Formosan Med. Assoc.* 73:173-177. Copyright © 1974.

swallows an infected copepod in drinking water, they can migrate from the gut and develop into plerocercoids, sometimes reaching a length of 35 cm. This infection is called *sparganosis* and may have severe pathological consequences. Cases have been reported from most countries of the world but are most common in eastern Asia. Yamane, Okada, and Takihara⁹⁸ reported a living sparganum that had infected a woman's breast for at least 30 years.

Another means of infection is by ingestion of insufficiently cooked amphibians, reptiles, birds, or even mammals such as pigs.²⁴ Plerocercoids present in these animals may then infect a person indulging in such delicacies. Many Chinese are infected in this way because of their tradition of eating raw snake to cure a panoply of ills.⁵³

A third method of infection results from the east Asian treatment of skin ulcers, inflamed vagina, or inflamed eye (Fig. 21.9) by poulticing the area with a split frog or flesh of a vertebrate that may be infected with spargana. The active worm then crawls into the orbit, vagina, or ulcer and establishes itself. Most cases of sparganosis in eastern Asia are probably caused by *Diphyllobothrium erinacei*, a parasite of carnivores.

In North America most spargana are probably *Diphyllobothrium mansonoides*, a parasite of cats.⁶⁹ It usually does not proliferate, except by occasionally breaking transversely, and may live up to 10 years in a human.⁹³ The current public awareness of the symptoms of cancer has led to an increase in reported cases of sparganosis in this country. Subdermal lumps are no longer ignored by an average person, and more than one physician has been shocked to find a gleaming, white worm in a lanced nodule. Wild vertebrates are commonly infected with spargana (Fig. 21.10).

Rarely a sparganum will be proliferative, splitting longitudinally and budding profusely. Such cases are very serious, since many thousands of worms can result, with the infected organs becoming honeycombed.⁶⁹

Treatment of sparganosis is usually by surgery, but supplementary treatment with praziquantel may be advisable.⁸⁶

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