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Source: Journal of Wildlife Diseases, 18(3) : 353-357

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-18.3.353

GASTRIC NODULES CAUSED BY "ANISAKIS TYPE" LARVAE IN THE BOWHEAD WHALE *(BALAENA MYSTICETUS)*

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During the collection of tissue specimens from bowhead whales harvested by Eskimos near Barrow, Alaska, in the spring of 1980, discrete, raised nodules were found on the gastric mucosa of two of six animals examined. Both whales were sexually immature; one was a male 10.8 m in length and the other a female 10.0 m in length. The nodules protruded about 1 cm on the mucosa of the nonglandular portion (forestomach) of the stomach and were firm, ovoid, whitish, and 1-2 cm in diameter (Fig. 1). The nodules were well

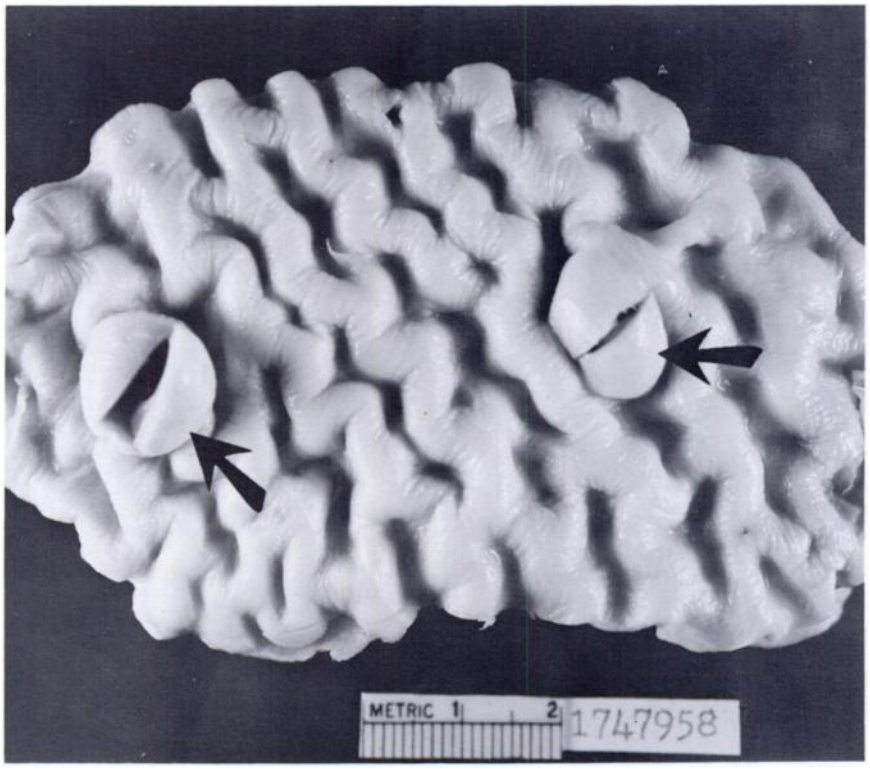

FIGURE 1. Dorsal view of two whitish nodules (arrows) protruding from the gastric mucosa. Nodules were incised for fixation purposes.

circumscribed, confined to the submucosa (Fig. 2), and contained cheesey, greenish yellow material.

Histologically, the nodules were composed of caseous necrotic granulomas characterized by large central areas of degenerating eosinophils that were surrounded by a wide zone of epithelioid granulation tissue followed by fibrous tissue. Cross sections of nematodes were found in the necrotic centers. The nematodes had cuticular annulations, coelomyarian muscles, an intestine composed of tall, columnar cells with a brush border, an excretory gland cell, and "butterfly"-shaped lateral chords (Figs. 3 and 4). Serial sections of the nematode revealed a lack of a fully developed reproductive organ, ventricular appendix, intestinal caecum, and alae. The tail was blunt, the anterior opening was surrounded by three lips, and dentigerous ridges were visible. These findings indicated that the nematodes were the larval stage of the family Anisakidae. They are referred to as "Anisakis type" larvae (Smith and Wootten, 1978, In: *Advances in Parasitology*, Vol. 16, Lumsden, Muller and Baker (eds.). Academic Press, New York pp. 93-163; Schmidt and Roberts, 1981, *Foundations of Parasitology*, Mosby, St. Louis, Missouri, 492 pp.; Dooley and Neafie, 1976, In: *Pathology of*

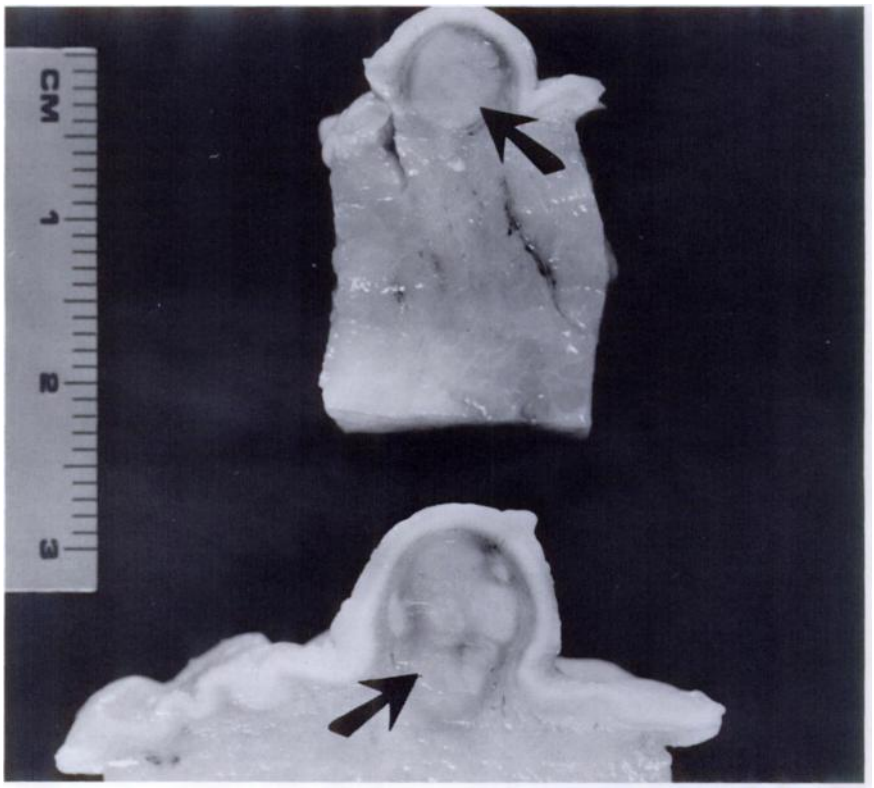

FIGURE 2. Cut surface of the nodules illustrating the nature of their contents (arrows).

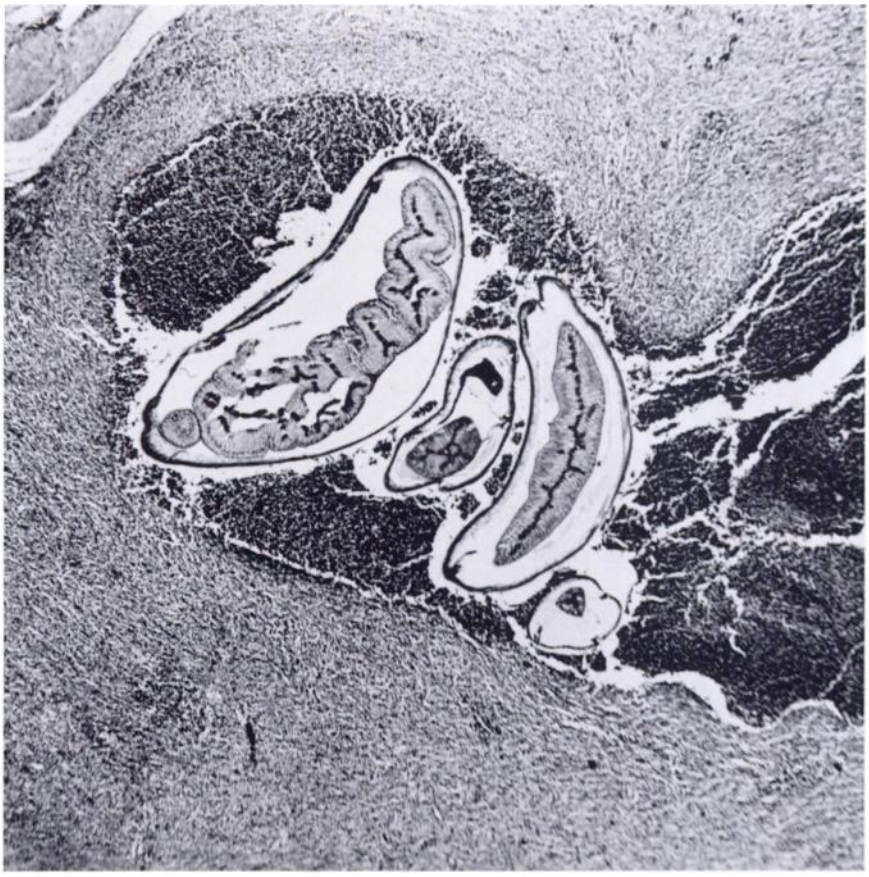

FIGURE 3. Transverse and tangential sections of an "Anisakis type" larva. H&E stain ×25.

Tropical and Extraordinary Diseases, Vol. II, Binford and Connor (eds.). Armed Forces Institute of Pathology, Washington, D.C., pp. 475-481). Since adult nematodes were not available for examination, positive identification of the larval nematodes as to genus and species could not be made (Myers, 1975, J. Milk Food Technol. 38: 774-782). Similar ulcerated nodules caused by "Anisakis type" larvae have been reported previously in the wall of the stomach of harbor porpoises *(Phocaena phocaena)* (Vik, 1964, Can. J. Zool. 42: 513-514; Young and Lowe, 1969, J. Comp. Pathol. 79: 301-313).

Although not completely understood, in general, the life cycle of these nematodes includes euphausiids and other crustaceans as the first intermediate hosts (2nd and 3rd stage larvae). Fish and squid (small and large) are second intermediate hosts (3rd stage larvae), and marine mammals are the definitive hosts (3rd and 4th stage larvae and adult nematode) (Smith and Wootten, op. cit.; Dailey and Brownell,

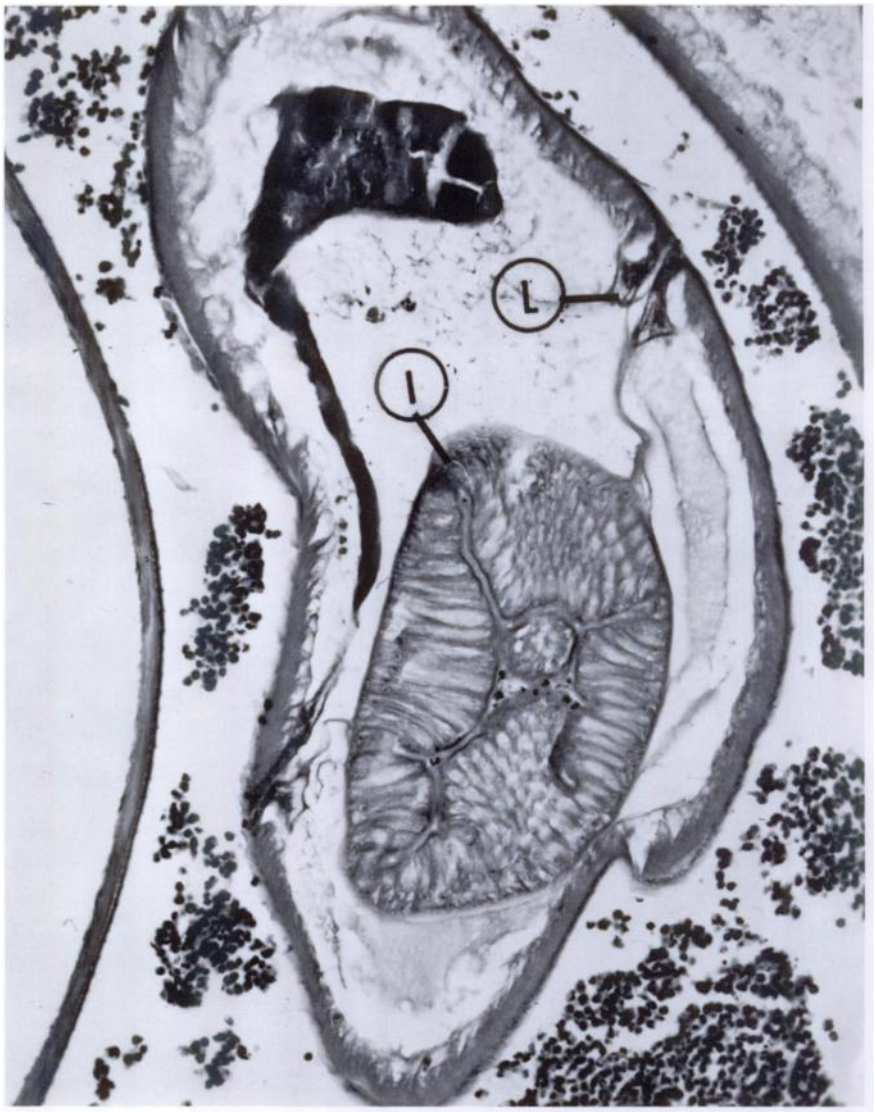

FIGURE 4. Higher magnification of a section in Figure 3. Note the "butterfly-shaped" lateral chords (L) and the intestine composed of tall, columnar cells with a brush border (I). H&E stain ×157.

1972, In: *Mammals of the Sea — Biology and Medicine*, Ridgway (ed.). C.C. Thomas, Springfield, Illinois, pp. 528-589).

The diet of the bowhead whale in Arctic waters consists chiefly of small crustaceans (Lowry and Burns, 1980, Mar. Fish. Rev. 42: 88-91). The ingestion

of larva-infected crustaceans could result in active penetration of the gastric wall by the larvae. Adult forms of anisakine nematodes have been found in the lumen of the stomach of toothed whales (Odontoceti) (Delyamure, 1955, *Helminthofauna of Marine Mammals*, Federal Scientific and Technical Information, Springfield, Virginia, pp. 206-248; Cowan, 1967, J. Parasitol. 53: 166-167; Von Thiel, 1966, Trop. Geogr. Med. 18: 310-328). Similar gastric nodules occur in man as a result of eating of raw, lightly salted or pickled fish containing infective larvae of *Anisakis* (Arean, 1971, In: *Pathology of Protozoal and Helminthic Diseases with Clinical Correlation*, Marcial-Rojas (ed.). Williams and Wilkins, Baltimore, Maryland, pp. 846-851). The adverse effects of these gastric nodules on the health of the bowhead whale remains undetermined. However, extensive ulceration of the nodules could result in ulcerative gastritis; deep penetration of the nematodes into the gastric wall could result in peritonitis.

This work was supported in part by Public Health Service Grant No. RR00301-16 from Division of Research Resources, National Institutes of Health, U.S. Department of Health and Human Services, under the auspices of Universities Associated for Research and Education in Pathology, Inc.; and Bureau of Land Management contract AA851-CTO-22 to the University of Maryland, College Park, Maryland.

Received for publication 10 November 1981