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OCULAR LYMPHOSARCOMA OF AN ATLANTIC COD, *Gadus morhua**

Malignant lymphoma, a tumor of lymphoid elements, occurs frequently in man, cow, dog, cat, and in the domestic fowl. It is a rarely reported tumor of the fish (Nigrelli, 1947, *Zoologica* 32: 101-108). Among these animals there are only 36 documented cases of lymphosarcoma, 29 (80%) of which involve members of the family Esocidae (Mulcahy, 1963, *Proc. Royal Irish Acad.* 63: 103-129).

Johnstone (1912, Report for 1911, Lancashire Sea Fisheries Laboratory 20: 33-74) described a lymphosarcoma involving the choroid layer of the eye in a flounder, *Pleuronectes flesus*. Plehn, (1924, *Praktikum der Fischkrankheiten*, E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart) reported abdominal lymphosarcoma of the goldfish *Carassius auratus*. Three other lymphomas involving the abdomen, with site of primary origin unknown, have been observed in the herring (*Clupea harengus*), the Conger eel (*Conger conger*), and *Rasbora lateristriata* (Johnstone, 1926, *Proc. Trans. Liverpool Biol. Soc.* 40: 75-98;

Williams, 1931, *Proc. Trans. Liverpool Biol. Soc.* 45: 98-109; Smith *et al.*, 1936, *Zoologica*, 21: 219-224). Haddow and Blake (1933, *J. Path. Bact.* 36: 41-47) and Nigrelli (1947, *Zoologica* 32: 101-108) described this type of neoplasm as arising from the lymphoproliferative tissue of the kidney in *Salmo salar* and *Esox lucius*. The tumor has been reported involving the "thymus" gland of the posterior branchial plexus in the characin, *Astynax mexicanus*, and in two instances the skin of Esocidae (Haddow and Blake, 1933, *J. Path. Bact.* 36: 41-47; Nigrelli, 1947, *Zoologica* 32: 101-108; Nigrelli, 1952, *Ann. N.Y. Acad. Sci.* 54: 1076-1092).

Schlumberger and Lucke (1948, *Cancer Res.* 8: 657-754), in a review of the world literature on neoplasia in fish, reported 23 tumors in the codfish, *Gadus morhua*, none of which were identified as lymphosarcoma.

The purpose of this paper is to report and describe the gross and histopathological lesions of ocular lymphosarcoma in an Atlantic cod.

Methods

The affected cod was collected at approximately 3 fathoms off the east shore of Fisher's Island, New York on the 12th of October, 1964.

All tissue for histological examination

was fixed in 10% formalin, embedded in paraffin, sectioned at 6 microns, and stained with hematoxylin and eosin, toluidine blue-0, Schorr's or Wilder's reticulum stains.

Results

The fish weighed 7.2 kilograms and was approximately 75 centimeters in length. External examination revealed a white, homogenous, firm, oval mass in the ventral portion of the anterior chamber of the left eye and a ventral scoliosis of the caudal vertebrae. There were no internal gross lesions.

The left eye was removed and sectioned mid-sagittally. The white mass filled the ventral portion of the anterior, posterior, and vitreous chambers extending from the ventral ciliary muscle posteriorly to the optic nerve. At its most anterior extension the tumor was present outside the circumorbital cartilage (Fig. 1).

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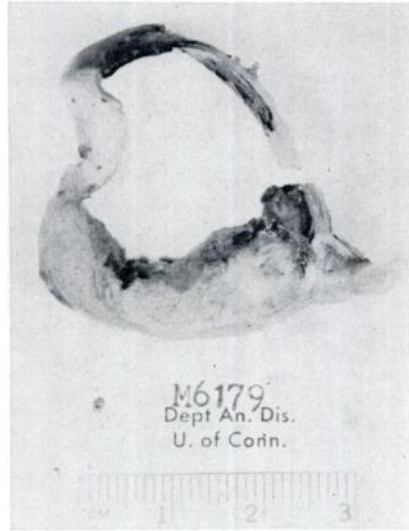


FIGURE 1. Longitudinal section left eye, cornea at left. Lymphosarcoma occupies ventral portion of globe.

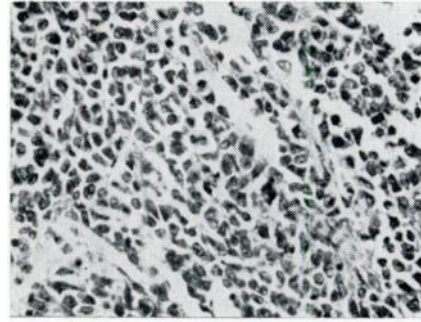


FIGURE 2. Sheet of anaplastic, pleomorphic lymphoid cells resembling reticulum cells. X 400.

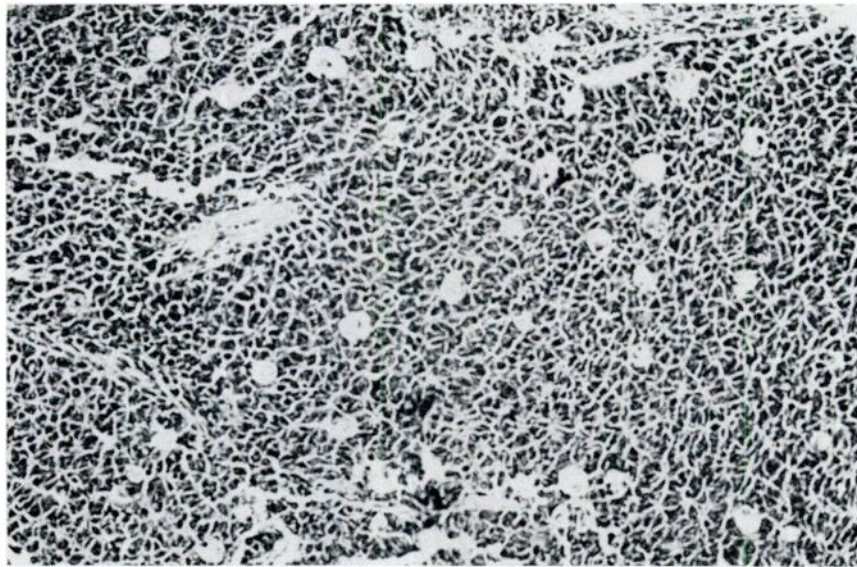


FIGURE 3. Section of tumor with "starry sky" effect. X 256.

Histologically, the neoplasm was composed of solid masses of a uniform cell type with variable sized areas of necrosis. There were often perivascular collars of viable tumor cells in the necrotic areas. The normal architecture of the involved retina, choroid, and sclera was completely destroyed, however the circumorbital cartilage was intact and not invaded by tumor cells.

The neoplastic cells were of lymphoid type with polyhedral shaped cytoplasm and a large vesicular nucleus which had a large single nucleolus and prominent

nuclear membrane (Fig. 2). Mitotic figures were common. Numerous macrophages ingesting cellular debris were scattered throughout the sheets of viable tumor cells creating the "starry sky" effect commonly seen in lymphosarcoma of cats, dogs, and cattle (Fig. 3).

No inclusion bodies, metachromatic granules or reticular fibers were demonstrated by the use of special stains.

A diagnosis of ocular lymphosarcoma (reticulum cell type) was made on the basis of histopathological observations.

Discussion

In man and other mammals with highly developed reticuloendothelial systems, the origin of malignant lymphomas is in the lymph nodes, spleen, and lymphoid nodules (Jubb and Kennedy, 1963, Pathology of Domestic Animals, Vol. 1, p. 305, Academic Press, Inc., New York). Metastasis to other organs is common as the disease progresses. It is under these circumstances that ocular lymphoma most often arises, whereas solitary involvement of the eye is very rare. Nonetheless, the ciliary body and retina are a rich source of lymphocytes and it is therefore possible for the tumor to arise spontaneously within the globe.

The site of origin in the fish, which lacks a highly developed reticuloendothelial system, appears to be the lymphoproliferative organs such as kidney, spleen, and "thymus" gland of the posterior branchial plexus. Histological examination of other organs of the codfish reported in this paper was not performed, therefore it is impossible to state that the true origin of the tumor was ocular.

The tumor was composed of primitive lymphoid cells which resembled reticulum

cells and had a histological picture similar to that seen in higher vertebrates with reticulum cell sarcoma. One of its characteristics was the so-called "starry sky" effect first described as an entity in the Burkitt lymphoma of man (Burkitt, 1958, Brit. J. Surgery 46: 218-223). The condition is commonly seen in lymphosarcoma of domestic animals and in hyperplastic lymph nodes and is not specific to the Burkitt lymphoma syndrome (Squire, 1966, Cancer 19: 447-453; Butler *et al.*, 1967, Am. J. Path. 51: 629-637). It is of interest to note that lymphosarcoma of the fish may also exhibit this histological pattern.

The etiology of this neoplasm in fish is unknown. Nigrelli (1952, Ann. N.Y. Acad. Sci. 54: 1076-1092) observed rod-shaped basophilic cytoplasmic inclusions in the neoplastic lymphoid cells of a lymphosarcoma in *Esox masquinongy* and suggested that the tumor might be of viral origin. Intracytoplasmic inclusions in sections of the codfish tumor were not demonstrated by the use of Schorr's stain. Viral isolation procedures should be performed in future cases of piscine lymphoma.

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