

FIBROSARCOMA OF THE SKIN IN A GOLD FISH (CARASSUS AURATUS)

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The fish, a gold carp, was obtained alive from a garden-pool of a hotel at St. Augustine, Florida; it died during transport, so that the study of the tumors was necessarily confined to a purely anatomical investigation. The pool contained very strongly sulphurous water, and was lined with rough, jagged rocks. The fish had lived in it for at least fifteen years; there were 4 other gold carp in the pool, all of which were apparently healthy.

GROSS DESCRIPTION

Female gold carp, 27 cm. in length, fully developed and well nourished. There are 3 tumors on the right side of the body all having broken through the epiderm (fig. 1). The largest is situated just laterally and somewhat anteriorly to the cephalic border of the dorsal fin. It is moderately firm, round in shape, measures 26 mm. in diameter and projects 15 mm. above the surface of the skin. In appearance it is dull white, its surface is generally smooth, but here and there are superficial ulcerations. At the periphery there is a number of fringe-like projections which extend like buttresses into the neighboring superficial tissue. The cut surface is dull white and almost homogeneous. In places, however, the tissue seems to be gathered into bundles which have a whorled arrangement. The bulk of the tumor is definitely external to the corium, but a considerable portion extends into the musculature and the tissues about the vertebral column. From gross examination it is not only impossible to decide its origin, but it is also difficult to judge as to

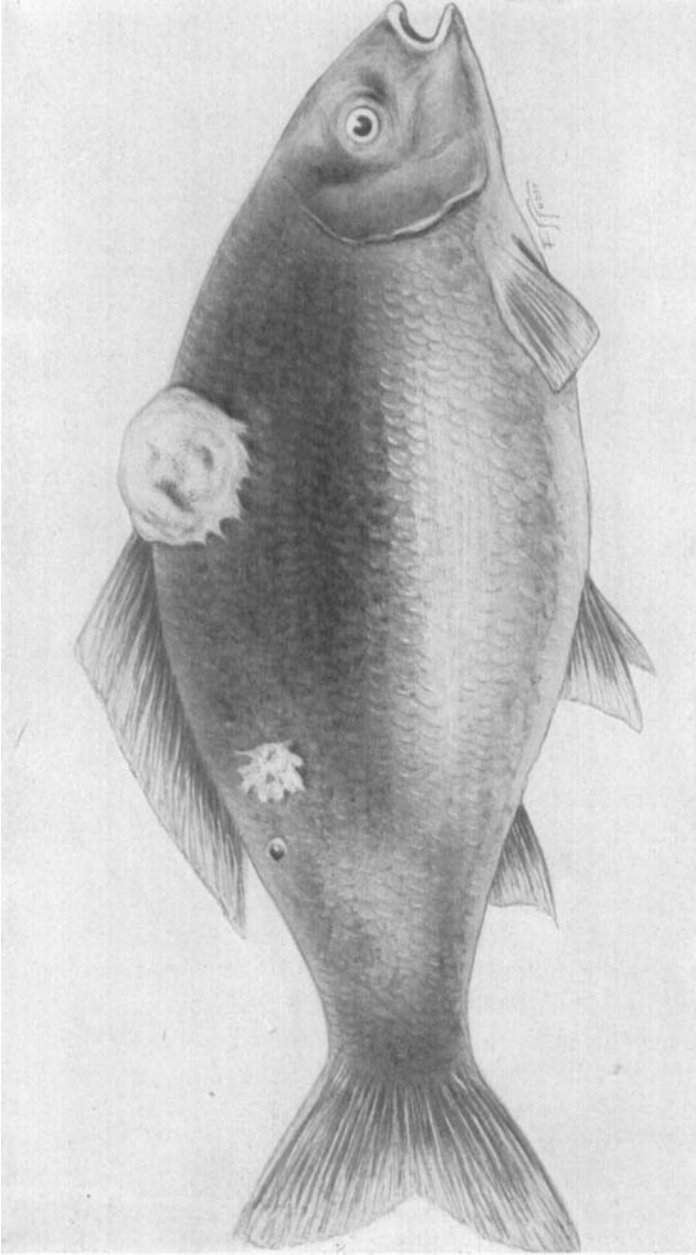


FIG. 1. GOLD CARP WITH CUTANEOUS FIBROSARCOMA

The larger nodule is probably the primary neoplasm; the two smaller tumors are looked upon as metastatic growths

whether the growth arises in the deep tissue and extends outwards, or whether the reverse is the case.

The second tumor has an irregular, somewhat star-like appearance, and lies a little anteriorly to the caudal border of the dorsal fin, and 1 cm. from the medial line. It projects 4 mm. above the surface and has an approximate diameter of 10 mm. Its external and internal appearance is like that of the larger growth, except that it is everywhere definitely external to the corium to which it is attached.

The third tumor is a little round nodule 3 mm. in diameter, about 1 cm. caudal to the second growth. It has the same general character as the second neoplasm.

The internal organs were examined grossly; no tumors were found. Portions of the tissues were fixed in formalin and stained with both haematoxylin and eosin, and Van Gieson's picro-fuchsin; other portions were fixed in Zenker's fluid and stained with Mallory's phosphotungstic acid haematoxylin, anilin blue, and eosin-methylene-blue.

HISTOLOGICAL DESCRIPTION

Largest tumor

The growth lies partly external, partly internal to the corium. The latter, however, is everywhere infiltrated by tumor cells, and in addition there is a moderate infiltration with small round cells, indicating probably a slight reaction on the part of the tissue. The corium is moderately compact at the periphery of the tumor, but its layers are more and more split and finally disappear entirely towards the more central parts of the neoplasm.

The growth is composed almost entirely of very loosely arranged spindle-shaped cells, which are frequently gathered into interlacing bundles, so that in the section the cells are cut in all axes (fig. 2). They are fairly large and resemble moderately mature fibroblasts. The cytoplasm is fairly abundant; at the points of the spindles it generally feathers out into fine fibrils which take the connective tissue stains, and communicate with similar fibrils of neighboring cells (fig. 4). The nuclei are

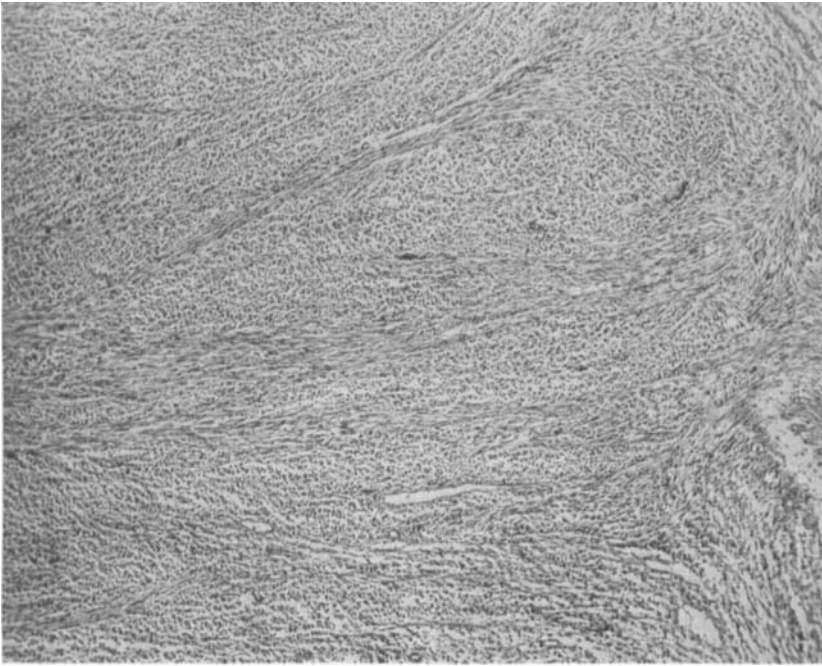


FIG. 2. FIBROSARCOMA OF GOLD FISH

Low power photograph showing the general character of the tumor. The cells are the connective tissue series, and are gathered into interlacing bundles.

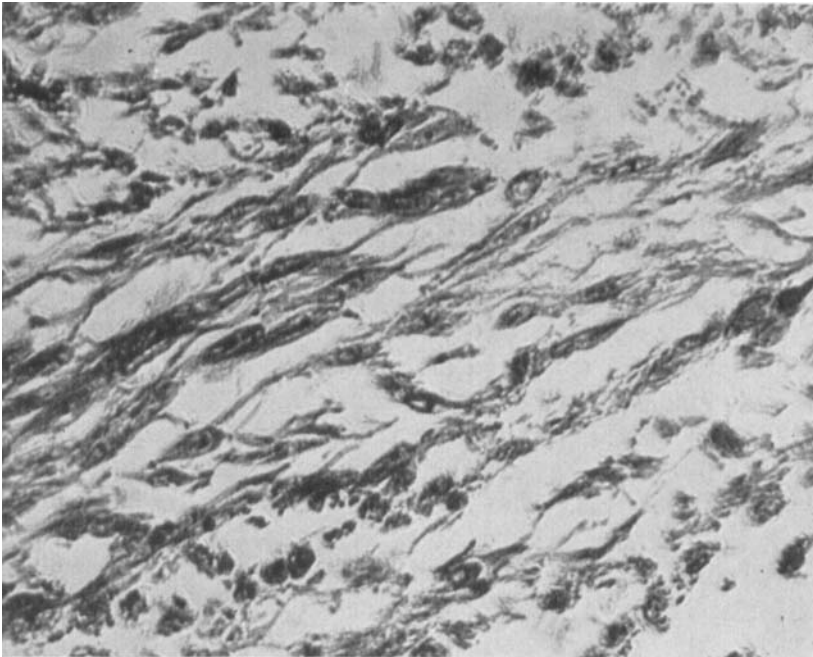


FIG. 3. FIBROSARCOMA OF GOLD FISH

Higher power photograph of portion of preceding figure, to show spindle-shaped character of the tumor cells and their loose arrangement.

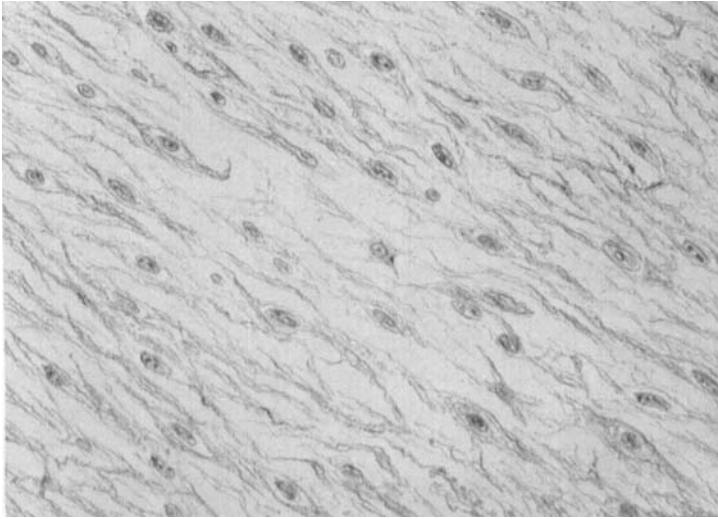


FIG. 4. FIBROSARCOMA OF GOLD FISH

The drawing shows the delicate fibrils at the points of the cytoplasmic bodies of the tumor cells.

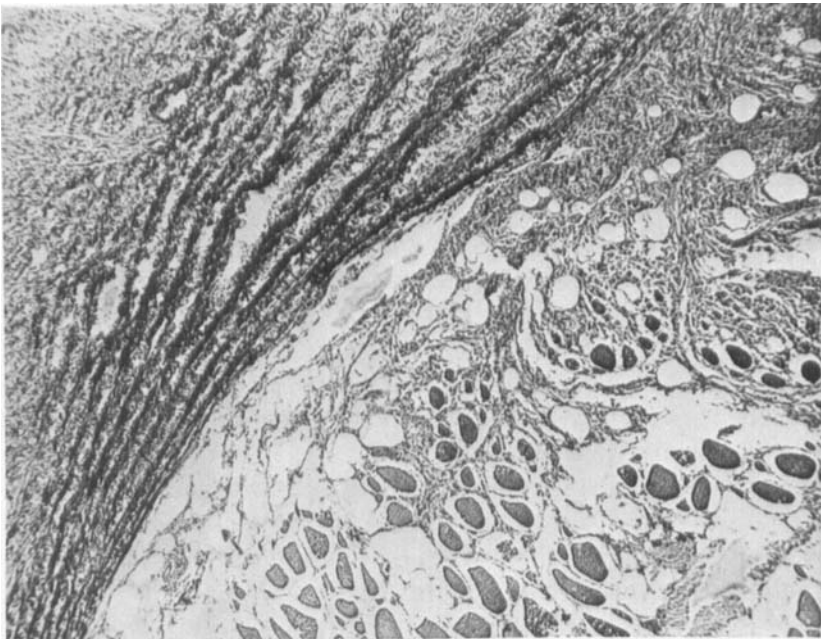


FIG. 5. FIBROSARCOMA OF GOLD FISH

The photograph shows the infiltrating character of the tumor. The corium is split, and invaded by neoplastic cells. The infiltration and destruction of the muscle tissue is apparent in the lower half of the photograph.

prominent and somewhat vesicular; the nuclear membranes are distinct; one or several dark staining nucleoli are usually present. Where the corium has been destroyed the tumor cells infiltrate the subjacent muscle tissue, which is distinctly atrophic and occasionally entirely replaced by the new growth (fig. 5).

Besides the cell type described there are a few large mononuclear elements with pale vacuolated cytoplasm and poorly staining round nuclei. In many portions of the growth, but especially where it is actively infiltrating, many irregular mitotic figures are seen.

The blood supply is extremely scanty; the vessels in all of the sections are very thin walled, consisting as a rule of a single layer of endothelial cells. Occasionally small irregular hemorrhages are found.

The smaller tumors have the same general cellular structure, but they do not penetrate the corium.

Search for parasites and particularly myxosporidia was unsuccessful. In all probability the growth is therefore a true neoplasm. Its general histological appearance is that of a very loosely arranged, moderately malignant fibrosarcoma.

DISCUSSION OF SPECIMEN

Analysis of the tumor shows one, the larger, to be infiltrating into the deeper tissues, while the others are external to the corium to which they are attached. The two smaller tumors may probably be looked upon as metastatic growths. This is of interest since, as will be pointed out below, the occurrence of metastasis is very rare in fish. The fibrous corium was probably the primary seat of the neoplasm. It is not possible to do more than speculate as to the causative factors, but it seems not unlikely that the fish sustained frequent cutaneous injuries on the rough rocks which lined its pool, and its advanced age would also favor neoplastic growth.

DISCUSSION OF FISH TUMORS IN GENERAL

Until 1900 only about a dozen instances of neoplastic disease in cold blooded animals had been reported, but since then a

considerable number of fish tumors has been investigated. This is partly due to the stimulation given by the researches in this field of Pick (1), Plehn (2), Fiebiger (3), Murray (4), Bashford (5), Schmey (6), Gaylord and Marsh (7), et al., and partly to the ever increasing economic importance of fish, necessitating more thorough knowledge of their diseases. The review of the literature by Schmey (6), and one more recent by Fölger (8), bring to light certain facts of general interest. Schmey found (in 1911) 59 reported cases of true neoplasm; these he tabulated as to type of tumor, organ involved, and species or genus affected. His tables show that almost all of the more important forms of benign and malignant tumors may occur in fishes. Thus there have been observed; osteoma, fibroma, lipoma, angioma, myoma, various forms of sarcoma, endothelioma, adenoma, papilloma, both "benign" and malignant epithelioma, and carcinoma. The thyroid, cutaneous surfaces and their appendages, musculature, intestinal tract, peritoneal cavity, urinary bladder, air bladder, oral mucosa, liver, and kidney have been recorded as the seat of the new growths.

The distribution is curious. Up to the present time, tumors have been found only in teleosts (bony fishes, to which most living forms belong), and particularly in the order Physostomi (the older classification of Hertwig, *Lehrbuch der Zoologie*, Jena 1909, has been followed). Two families belonging to this order, the salmonoid and ciprinoid fishes, have furnished the greatest number of cases. These two families are furthermore of special importance since they furnish examples of neoplasms confined to a particular group of fish, in which they are apt to occur endemically or epidemically. Probably the most intensively investigated form is the thyroid cancer of the salmonoids, popularly known as "throat tumor," or "gill disease." This disease has been known for about thirty years, and manifests itself as a rapidly growing tumor on the floor of the mouth and on the gills, which usually terminates fatally. It has been studied on a large scale by Gaylord and Marsh (7), in whose monograph (1914) it is shown that while most of the tumors have been found in domesticated fish (from fish breeding stations, etc.), they have

been observed also in fish caught in their native condition. There can be no doubt that the growth represents a true carcinoma, nor that a living organism is its causative factor, but no evidence has been found to indicate the direct transmission from individual to individual, except that epidemics break out in certain localities and thus make its transmissible nature probable. Gaylord and Marsh were able to induce analogous tumor growth in mammals by administering with drinking water the scrapings from the inner surfaces of wooden troughs which had harbored tumor fish. The tumor-producing substance was destroyed by boiling. Fish in all stages of the disease were favorably affected in the direction of cure by the addition to the water supply of mercury, iodine, or arsenic in suitable concentrations. Spontaneous recovery also occurred in a considerable percentage of individuals, and some strains appeared immune to the disease. The great importance of this research for comparative oncology as well as for practical fish culture is apparent.

The other most widely spread form of tumor is the so-called "pox" of carps. It, like the thyroid cancer of the salmonoids, is apparently confined to a single family, the cyprinidae (carp family). The condition manifests itself as an epithelial hyperplasia; it begins as milky opaque cutaneous plaques, which gradually become thicker and project for several millimeters above the skin surface. They are usually tough, like cartilage, and readily detached from the subjacent corium. The cause of the "pox" is a disputed subject. The early observers (Hofer (9), Döflein (10)) believed the growth to be parasitic in origin, but they were unsuccessful in demonstrating either vegetable or animal parasites within the lesions. Later, these investigators held that the skin lesions were due to parasites, but indirectly, since within the kidney of the affected carp, myxosporidiae (*Myxobolus cyprini* Hofer) could be found practically always. It was argued that the myxobolus infection so lowered the functional capacity of the kidneys that metabolic products otherwise eliminated by them were now vicariously excreted through the skin, and that either through constant irritation or through hyperactivity, a cutaneous hyperplasia resulted. It was, however,

shown by Plehn (2), Fiebiger (3), and others that myxosporidiosis occurred quite commonly in carp not affected with "pox," and that, on the other hand, some fish with "pox" did not contain the parasites in any of their internal organs. At present the majority of observers, therefore, hold that the theory of Hofer and Döflein is not supported, and that the cause of the disease is still unknown. There is also some disagreement as to the nature of the process. Plehn looks upon it as a benign hyperplasia, which only occasionally becomes infiltrative and malignant. Fiebiger is inclined to believe that under the term "pox" or "benign epithelioma" several very different conditions have been described, and that the epidemic "pox" is nothing more than an inflammatory overgrowth of the epiderm.

As to other tumors, we find a great variety of types in both sea-fishes and fresh water fishes. Their histological structure is quite comparable to that of mammalian neoplasms, but there are certain outstanding differences in their behavior. Thus the occurrence of metastasis is rare, even in growths which tend to destroy life and which histologically have an infiltrative and locally destructive character. Gaylord and Marsh, in their extensive series of thyroid cancers, observed only a single instance of unquestionable metastasis to internal organs, and only a few examples of doubtful metastasis. Similarly Schmey, in his compilation, records only two metastasizing tumors, both sarcomata. The epithelioma of a catfish reported by McFarland (14) and the fibro-sarcoma described here are the only other examples of true metastatic growth which we have been able to find recorded. At the present time, no explanation can be offered for this rarity of metastatic dissemination.

The neoplastic nature of a fish tumor is not always easily recognized. Murray (4) emphasized particularly the difficulties which confront the pathologist when studying sarcoma-like growths, since our knowledge of inflammatory reaction in cold blooded animals (and indeed in most animals) is as yet very scanty.

Kitt (11) states that in fish the skin is the most frequent seat of neoplasms, and explains this on the ground that the cutaneous surfaces are most liable to frequent injury. This statement

is borne out by a review of the literature only if the numerically very frequent "pox" of the cyprinoid family is included. Fiebiger, in his paper on the skin tumor of fishes, gives a very good account of the normal histology of the cutaneous structures and reports several epitheliomata, a fibroma, and a multiple papilloma. An osteoma and a sarcoma have been noted by Schröder (12), carcinoma in a carp by Bashford, and a carcinoma in a gold fish by Dauwe and Pennemann (13).

McFarland (14) was probably the first to study cutaneous epithelioma in the fish; his report occurred in the transactions of a pathological society and seems hitherto to have been overlooked. The tumor, an epithelioma of the mouth and skin of a white catfish (caught in Pennsylvania), is of further interest in that probably it is an example of true metastasis. A number of tumors were present; the largest arose from the lower jaw and projected into the mouth, probably interfering with its closure. It measured almost 4 x 2.5 x 1.75 cm., was papillary, greyish-white, and had an ulcerated surface. Numerous nodules occurred along the edge of the upper jaw; others about the eyes and the inferior surface of the neck; these nodules appeared to be purely dermal, and probably secondary to the growth in the lower jaw. There were no tumors in the gills, upon the body, or in internal organs. Histologically the neoplasm was an infiltrating papillary squamous epithelioma, arising probably from the oral mucosa.

Lastly, as to tumors hitherto described in goldfish, we are able to find but two instances in the literature, a skin cancer, reported by Dauwe and Pennemann, and a cancer of the urinary bladder described by Plehn. This is the more surprising since hybrids and domesticated fishes appear to suffer more commonly from neoplastic diseases than pure or wild species. It may be, of course, that tumors in this species have not been brought to the attention of pathologists, and that more extensive investigation would bring to light further instances. Since the gold fish is almost entirely an aquarium specimen, thoroughly domesticated and used to room temperature, it would seem to be ideal for experimental tumor studies, and it is hoped that the present report may draw attention to this problem.

SUMMARY

1. A fibrosarcoma of the skin of a gold carp is reported.
2. This tumor gave rise to metastatic growths, a rare occurrence in fishes.
3. As far as we are able to learn this is only the third instance of neoplastic disease reported in goldfish.

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