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Surgical Removal of Retrobulbar Hemangioma in a Goldfish (*Carassius auratus*)

Bradley J. O'Hagan, BVSc, MACVSc[a,*],
Shane R. Raidal, BVSc, PhD, FACVSc[b]

[a]*Research and Development, Jurox Pty Ltd., 85 Gardiners Road, Rutherford, New South Wales, 2320, Australia*
[b]*Veterinary Pathobiology, Charles Sturt University, Wagga Wagga, New South Wales, 2650, Australia*

Goldfish (*Carassius auratus*) have long been kept as pets, and serious aquarists who invest significant amounts of money in their hobby can become emotionally attached to their fish. This factor, along with heightened societal expectations for animal welfare, has provided an increased scope for the provision of veterinary services to pet fish owners. Few publications describe the surgical treatment of tumors in pet fish such as goldfish, despite the high value placed on individual fish and their ancient history of being kept as ornamental pets. Goldfish are a long-lived species that appear to have a high prevalence of neoplasia [1–4]; information on predisposing factors and the prognosis for various treatment options remains lacking [2]. Hemangioma is an uncommon or unreported cause of neoplasia in goldfish, although it has been reported in other species of fish. The following report outlines the clinical and pathologic findings, surgical intervention, and postoperative management of a case of exophthalmosis caused by a retrobulbar hemangioma in a goldfish.

Case history

A mature fantail goldfish was presented with a 6-week history of a swollen right eye. The fish had also been noted to have significant congestion of the vessels of the tail and the fins. No improvement had resulted from

* Corresponding author.
E-mail address: brad.ohagan@jurox.com.au (B.J. O'Hagan).

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treatments attempted by the owner, which included a tank multicure and malachite green. Details obtained from the owner about the treatment regimens used and the duration of the treatments were vague.

Marked exophthalmosis of the right eye was observed, with smooth red tissue present on the dorsal and lateral aspects of the globe. Vascular congestion of the fins and tail was noted. The fish appeared to be blind in the right eye, as evidenced by constant bumping of that side of the body against the walls of the bucket in which it was presented. Analysis of the water from the tank revealed a slightly elevated ammonia concentration (0.6 mg/L) but acceptable pH (7.6) and nitrite (<0.1 mg/L) and nitrate (50 mg/L) concentrations.

For reasons of owner finances, the decision was made to remove the eye under anesthesia rather than attempting to make a diagnosis before proceeding to surgery.

The fish was placed in a tank of aged water. Alfaxalone (Alfaxan-CD RTU) was administered to the tank in increments up to a concentration of 5 mg/L of water, at which point the fish slowed its gill excursions significantly and lost its equilibrium and neutral buoyancy. The fish was removed from the tank and placed on wet towels with the right eye uppermost. The fish was constantly delivered water containing the anesthetic agent via the mouth and across the gills by syringe. Gill clips and skin scrapings were performed. There was no evidence of surface parasites on mucus examination and no evidence of parasites or gill filament blunting on wet-mount evaluation of the gill clips. An attempt to aspirate soft tissue from behind the eye was made using a 5-mL syringe and 25-gauge and 22-gauge needles. No significant volume of tissue was obtained.

The eye was grasped with a pair of forceps and excised from the orbit using curved scissors. Remaining red tissue, similar to that apparent on the eye, was stripped from the inside of the orbit using a bone curette. Minimal bleeding from the optic stump occurred, and no ligatures were required. The fish was administered enrofloxacin, 5 mg intraperitoneally, and then placed in a tank of fresh, oxygenated, aged water without anesthetic. Oxygenated fresh water was syringed through the mouth, and the fish was held upright and moved through the water as though swimming to increase water flow over the gills and oxygenation. Within 15 minutes, the fish was maintaining neutral buoyancy and had regained its equilibrium. After 1 hour in the oxygenated water, the fish was returned to a larger tub with only filtered fresh water, with salt added to it at a concentration of 2 g/L. Approximately 4 hours after surgery was completed, the fish was found to have lost its ability to remain upright; it was swimming with its enucleated side down and ventilating with irregular, shallow gill movements. Methadone was administered at a dose of 0.4 mg intramuscularly. Within 20 minutes of administration, the fish was again swimming normally, and the respiration pattern had improved. The fish was maintained in the recovery tub for the next 7 days, with daily 25% water volume changes and maintenance of a salt

concentration of 2 g/L. The fish was medicated with enrofloxacin, 5 mg by intramuscular injection every 2 days, and was fed a commercial flake diet while recovering. When returned to the owners, the fish was maintained in isolation for 3 weeks in water containing salt at a concentration of 2 g/L and was then returned to its home tank after gradual acclimatization to its water and temperature.

The excised eye was fixed in 10% buffered formal saline and processed for routine paraffin embedding, staining, and histologic examination. Hematoxylin and eosin–stained sections demonstrated that the tumor was well demarcated and composed predominantly of a disorderly network of well-differentiated, compact, blood-filled capillary channels lined by endothelium (Fig. 1). More cavernous spaces filled with erythrocytes were present in other areas. Immunohistochemical staining for Factor VIII was negative; however, normal goldfish vasculature tissues from the same and other fish were also negative.

Discussion

Goldfish have been kept for ornamental purposes since 600 AD in China [2]. Reports of pet numbers in the United States indicate that more than 148 million fish are kept as pets [5]. Despite this long history and large number of owners, the field of fish medicine and surgery is in its relative infancy.

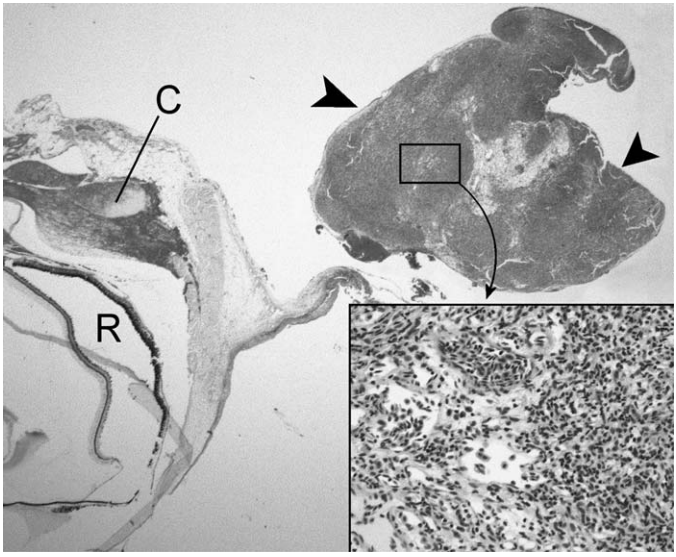

Fig. 1. Histologic examination of the excised eye, showing the choroid body (C), detached (artifact) retina (R), and a well-demarcated, pseudoencapsulated hemangioma (*arrowheads*) composed of well-differentiated vascular channels containing erythrocytes (*insert*) (hematoxylin-eosin, original magnification ×10).

Because of the close relationship of the fish with its environment, changes in the environment can result in serious disease and death of fish. The intensive nature of the aquarium increases the likelihood of imbalances of several chemicals that may prove to be mildly irritating, immune-suppressing, or even fatal.

Aquarists commonly treat health problems in their fish with proprietary tank treatments on the advice of pet and aquarium shop owners. It is often only after several unsuccessful attempts at treatment that they consult a veterinarian. This pattern can interfere with diagnosis, particularly when the exact composition of proprietary medications is not known. In the case presented, the owner had treated the tank previously with a multicure tank treatment, as well as with malachite green. Malachite green is a known carcinogen, and it should no longer be used for therapeutic administration [6]. The swelling to the eye of the presented fish was, however, apparent before treatment. No other fish in the tank showed signs of illness.

Water management procedures practiced by the owners were acceptable with regard to routine water changes. However, the water added at each change was not aged or dechlorinated, and the owners reported that the fish would often swim about erratically for several hours after the water was added. The general range for chlorine in Australian reticulated water supplies is 0.1 to 4 mg/L, with the typical concentration being 0.2 mg/L [7]. Chlorine can be extremely toxic to fish, and levels as low as 4.0 mg/L (ppm) can be fatal within 8 hours, whereas levels as low as 0.2 mg/L will kill fish over 20 days [8].

Elevations in ammonia and nitrite levels in the tested tank water are an indicator of a poorly developed nitrogen cycle. The nitrogen cycle is a normal microbial cycle that is established in the filters and substrates and is vital to the conversion of the highly toxic ammonia to the toxic nitrite and then to the much less toxic nitrate. The nitrogen cycle can take some time to become established in a tank. However, in this situation the tank had recently had a complete water change, due to a relocation of the aquarium, and the water used to refill the tank was chlorinated water direct from the domestic water supply. This process may have resulted in significant die-off of the organisms responsible for the nitrogen cycle.

Skin scrapings and gills clips are routine diagnostic procedures to evaluate parasitic infestations in fish. The clips and scrapings from this fish revealed no evidence of parasite infestation.

Anesthesia of fish has been induced with many different compounds, including eugenols, barbiturates, and ketamine. In this instance the fish was induced using alfaxalone in cyclodextrin at a concentration in the water of 5 mg/L. This is slightly higher than the dose range of 1.5 to 4.0 mg/L reported by Greenwood [9]. The maintenance of oxygenation and heart rate in fish while under anesthesia relies on constant flow of water across the gills of the fish in a normograde fashion. This effect was accomplished by using a syringe to deliver the aerated water containing alfaxan. Gravity-powered

infusion is a viable alternative for longer procedures [9]. After the completion of the surgery and diagnostics performed on this fish, oxygenated water free of anesthetic agent was administered to the fish, and the fish was returned to a recovery tank with oxygen bubbled through it using an airstone.

Salt was added to the water postoperatively to help the fish compensate for loss of osmoregulation, which often occurs after handling and surgical interventions breach the normal mucous coating of the fish.

Considerable debate exists as to whether fish experience pain. Much of this debate revolves around the definitions of pain and the anatomy required to perceive something as painful. Postoperatively, this fish had a period of significant disorientation and loss of buoyancy. The administration of an opioid analgesic medication—methadone—resulted in a rapid return to normal behavior, perhaps indicating a positive response to the use of analgesia.

Postoperatively, the fish was kept in isolation for 5 weeks before being returned to its normal tank.

Hemangioma is commonly diagnosed in salmonid fish; however, this is the first report of a hemangioma developing in a goldfish. Generally, hemangiomas are locally invasive tumors that, once diagnosed, indicate a poor prognosis for the fish. However, in this case the fish was still alive and well some months after surgery.

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