Treatment of Diseases in Pond Fish

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Pond fish, especially koi, are becoming popular animals to include in landscaped pools, and it is increasingly common for fish owners to call their local veterinarian with questions about the health of the fish in their garden. Successfully treating a fish can lead to a new appreciation for these fantastic animals and, perhaps, a greater interest in this relatively new, exciting area of exotic animal medicine.

Assessment of the Patient and Environment

As with all exotic animal patients, a thorough history is important to gain critical background information. A specific set of questions should be asked to help characterize the problem(s) being evaluated (e.g., Are all the fish in the pond affected? Was there a sudden onset of clinical signs? Is only one species affected? Were fish found dead in the morning?). A detailed description of husbandry practices is also very important (e.g., What is the feeding routine? What kind of filtration system is used? Are new fish quarantined?).

Once all background information has been obtained regarding the case, a water quality test should be performed. Kits for this purpose are available from several manufacturers. If problems are noted in the results of the initial water quality test, a more comprehensive water analysis might be necessary.

Just as good air quality is important for human health, clean water is essential for the health of fish. Fish live constantly immersed in an environment that can be described as a “bacterial soup.” This environment must be well balanced at all times; otherwise, a number of conditions can eventually predispose the fish population to infectious disease. In aquatic settings, infectious organisms often cause secondary disease conditions (e.g., fin rot, FIGURE 1) after nonspecific stressors (e.g., overcrowding, poor water quality) have weakened the fish’s immune system. Correction of the primary problem associated with the underlying disease condition is the key to a successful resolution of the case.

If the results of the environmental assessment are normal, the next step is to examine the affected fish. If a fish is to be brought to the veterinary clinic/hospital for examination, the client should also bring a water sample in a separate container (a few milliliters of water is adequate), along with photographs of the pond to help describe the size and setting of the pond. When the examination takes place at the pond, the fish should be observed and any abnormal behavior or swimming patterns noted before handling. Abnormal swimming patterns include “jerking” or turning one side up to the surface of the pond. Turning sideways—a behavior called flashing because light is reflected from the scales—may be a response to ectoparasites. If a fish is brought to the clinic, it should be placed in a transparent container to allow the clinician to perform a close visual inspection and assess the patient from all angles.

Handling the Patient

After visual inspection of the fish, hands-on examination procedures can be performed. These procedures may include biopsies, skin scrapes, radiography, phlebotomy, and injections. The veterinarian performing the examination should wear gloves at all times to protect the fish from trauma caused by hands and to protect him- or herself from possible zoonotic disease.

For individual cases, anesthesia may be indicated for examination or diagnostic procedures (FIGURE 2). Tricaine methanesulfonate (MS-222, 75 to 100 ppm [mg/L]) may be used 5 minutes before starting a diagnostic procedure. It is important to buffer this anesthetic solution with sodium bicarbonate, as MS-222 significantly decreases the pH of water. The buffer is usually added at

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Figure 1. Fin rot is a common presentation. Note the bloodshot fins, which are severely damaged.
twice the dose of MS-222 (e.g., if a stock solution of 10 g/L of MS-222 is used for anesthetic induction, an equal amount of a buffer solution of 20 g/L of sodium bicarbonate should be used).

I have used clove oil for many procedures that require anesthesia, with excellent results. Clove oil can be purchased at a local pharmacy, is inexpensive, and appears to be nontoxic to humans. One milliliter of clove oil contains 1 g of eugenol and is diluted with ethanol to a 100 mg/mL solution (1:10 dilution). This 1:10 dilution of eugenol and ethanol serves as a stock solution and can be used from 40 to 120 ppm (mg/L). In general, recovery seems a little longer and the fish seem to have marked respiratory depression when eugenol is used compared with fish administered MS-222. It is important to note that MS-222 is the only FDA-approved anesthetic agent for fish at the current time.

Postmortem Examination
If a fish die-off has occurred and the owner requests a necropsy, remember that only necropsies on fresh carcasses yield useful information. Once death occurs, postmortem autolysis immediately starts, parasites rapidly leave the host, and there is an immediate increase in bacterial growth. (For a detailed description of a recommended fish necropsy procedure, see Stoskopf in the Additional Readings list.)

Treatment
It is impossible to list here all the pharmaceuticals used in fish medicine. Below are a few popular treatment recommendations with which veterinarians who treat fish should be familiar.

Methods of Drug Delivery
The most common routes for administration of drugs in fish are injection (usually intramuscular into the dorsal musculature or intracoelomic), topical application (e.g., of an ointment), and oral. Medicated foods can be either fed on an mg/kg body weight basis or force fed to the fish in a “homemade” slurry. When force feeding a sick fish, take care not to spill food over the gills or damage the gastrointestinal tract with a food applicator. Drugs can also be mixed into gel foods, which are then fed according to formulary doses.

Another form of drug delivery is via exposure of the fish to medicated water. There are three methods of exposing fish to medicated water that differ in exposure time and drug concentration:

- **Dip**—Drug concentration is high and exposure time is short (1 sec to 15 min).
- **Bath**—Drug concentration and exposure time are moderate (15 min to 24 h).
- **Constant exposure**—Drug concentration is low and exposure time is long (>24 h).

Salt
Table salt (without iodine) is an effective treatment for many disease problems in fish. A freshwater fish is hyperosmotic in comparison to its environment. Keeping freshwater fish in mildly salted water (0.2% or 2 ppt; equivalent to 2 g/L or roughly 1 lb/100 gal) reduces the osmotic pressure on the excretory organs. (For comparison, the salt concentration in a saltwater tank is about 30 g/L.) In cases of severe organ failure (e.g., kidney failure), water is not excreted as efficiently, giving the fish a “pinecone” appearance (FIGURE 3). These patients can benefit from being kept in mildly salty (0.2%) water. A 0.2% salt concentration is also capable of killing most parasites, including “ich” (*Ichthyophthirius multifiliis*). Salt can also be used to treat nitrite toxicity. Some pond owners maintain their fish indefinitely in a mild salt solution at 1 lb of salt/100 gal of water.

Hydrogen Peroxide
Low levels of dissolved oxygen (DO) are a common problem in pond environments. In the summer, the concentration of DO drops
dramatically as the water temperature rises and plants thrive. During the night, plants are in the dark phase of photosynthesis, in which they consume oxygen, resulting in a decrease of DO. A 3% hydrogen peroxide ($\text{H}_2\text{O}_2$) solution can be used at a concentration of up to 240 mL/100 gal of water to increase the DO content in a pond. Benchmark levels of DO should be maintained around 10 ppm. It is important to remember that peroxide itself is a very caustic agent that can also significantly injure fish. The gills are especially sensitive and can be easily damaged if the concentration of the peroxide is too high or if the peroxide is applied in close proximity to the fish. As a dip to treat ectoparasites, hydrogen peroxide can be used at 66.5 mL/gal (17.5 mL/L) for up to 10 minutes. If the fish shows signs of distress (e.g., erratic swimming, rapid breathing) during the dip, immediately end the treatment.

**Potassium Permanganate**

Potassium permanganate (KMnO$_4$) is effective in treating many conditions, but it is also capable of harming pond fish populations if not properly applied. This excellent antiparasitic and antibacterial agent and disinfectant is primarily used to treat bacterial infections. However, it is capable of destroying the nitrification bacteria in the filtration system. The destruction of nitrification bacteria can result in a chemistry imbalance of the aquatic environment. Caution should be used when potassium permanganate is applied to fish at a high concentration (i.e., as a dip), as it can be caustic to the gills and significantly injure the fish (similar to hydrogen peroxide). Potassium permanganate also draws oxygen from the aquatic environment, which can cause problems in aquatic environments that have a low DO content before the chemical treatment.

When applied correctly, potassium permanganate can be used to kill fish flukes. Application of 3 ppm for approximately 8 hours can eliminate gill flukes, reduce the number of gram-negative bacteria, and effectively treat fungal diseases (e.g., *Saprolegnia* infection). If fish are dying due to hydrogen sulfide ($\text{H}_2\text{S}$) intoxication, 2 ppm of potassium permanganate can prevent further buildup of this toxin in the environment. For a detailed discussion of potassium permanganate, see the Additional Readings list, especially Johnson.

**Ice Packs**

Lowering the water temperature to below 75°F is a simple way to increase the DO content of an aquatic environment. This can be done by throwing ice packs into the pond.

**Baking Soda**

Baking soda is a great tool in the fish pharmacy to correct low (<7) pH values. A concentration of 10 to 20 tsp/100 gal is usually sufficient to correct the chemical balance in an aquatic environment that has sustained a sudden drop in pH.

**Conclusion**

Intensive fish medicine is a growing area within the veterinary profession as more people are requesting a similar level of care for their fish as they expect for their dogs and cats. Well-informed clients can be of great assistance during the clinical workup. A teamwork approach to fish husbandry, nutrition, and medicine between the owner and veterinarian will yield the most satisfying and successful health care results.

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**Additional Readings**