CLINICIAN'S NOTEBOOK

Building a Fish Anesthesia Delivery System

An inexpensive, portable and efficient fish anesthesia machine for use in prolonged procedures can be constructed from easily available materials.

Red devil cichlid, *Heros labiatus*

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Adapted from wet lab presentation, 1998 Conference American Association of Zoo Veterinarians, Omaha, NE.

Water-borne anesthesia is the most widely used route of anesthetic administration for fish. For bath treatment, the drug can be brought to the desired concentration in water containing the fish, or the fish can be placed in an induction tank containing anesthetic.

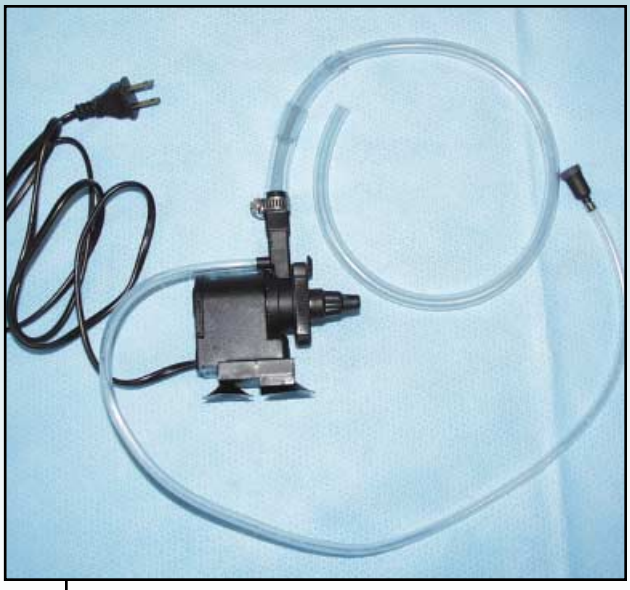
Minor clinical procedures can be performed on anesthetized fish briefly removed from the water for the necessary manipulations and either returned to the anesthesia tank to extend the procedure or moved to recovery water when the task is completed. More involved out-of-water surgery requires continuous delivery of anesthesia water to the patient's gills. A low volume, non-recirculating, gravity-fed system comprised of an IV fluid bag reservoir, drip set, and red rubber catheter works well for small fish patients. Larger capacity recirculating systems have been described using two tanks with a pump or a siphon and pump.

The simplified system illustrated here with a single tank and pump provides an effective and economical technique for delivery of anesthesia to a fish patient for extensive out-of-water procedures that is applicable both to mobile and in-house practice settings.

Components

The components of the fish anesthesia delivery system (FADS) are listed in Table 1. In most cases a ten gallon aquarium will be of adequate size to serve as the reservoir and support for the FADS. Once the aquarium has been cleaned and rinsed with hot water, the submersible pump (power head) is secured to the inside of the aquarium near the bottom of the tank with its suction cup attachment. Most commercial power heads are equipped with a venturi tube for aquarium aeration. Because stepping down the anesthesia hose diameter increases back-pressure, the venturi tube can act as an irrigator or "baster" for the anesthetized fish patient.

Assembly



1 A submersible aquarium pump (power head) with venturi tube serves as the water delivery system for the FADS. A 5-10 cm (2-4") piece of each diameter of transparent tubing is cut, and the pieces telescoped together to form a 20-40 cm (4-7½") length of anesthesia hose.

2 The final diameter of the telescoping water delivery tubing should be the longest length and should be appropriate for the size of the patient's buccal cavity. The base portion of the composite tube can be clamped to the power head outflow with a plastic clamp. The venturi tube should be capped when not in use for moistening the patient.

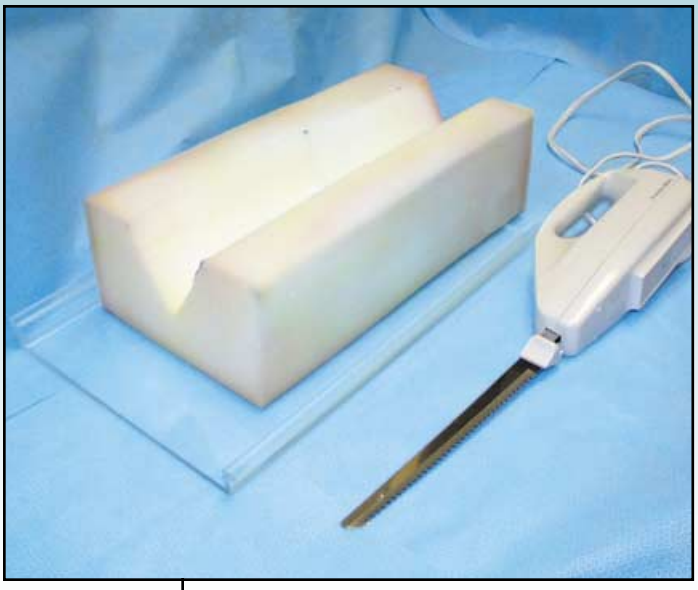
Plexiglass® support for the foam can be constructed by a custom Plexiglass® fabrication firm. The support is designed to hang slightly below the top of the aquarium so water drains back into the tank and not over the sides. The inside edges of the Plexiglass® should be polished to avoid cuts.

Soft open-cell foam, saturated with water and with a V-slot cut to accommodate the fish, helps with positioning, maintains moisture where in contact with the fish, and allows water to flow through for collection.

Supplemental aeration or oxygenation is mandatory because anesthetic agents tend to cause respiratory depression. Aeration can be supplied with a free standing air pump and air stone, available from pet stores.

Table 1 Fish Anesthesia Delivery System Components

Component	Source	Approx. Cost
210 Hagen power head	most pet stores	$15-25
Flexible plastic tubing (6 inches each of 1/2", 3/8", and 1/4" internal diameter)	hardware stores	$1-2
1 ten gallon aquarium	most pet stores	$6-12
1 Plexiglass® support	custom made - Plastic Art Design 919-878-1672	$15-20
1 open cell foam surgery platform	fabric/textile outlet	$1-5
1 hose clamp	hardware store	$.50
	Total cost of a FADS unit:	$38.50-64.50



3 A custom-made 6 mm (1/4″) Plexiglass® support is made to fit securely on the ledge of the plastic rim of the aquarium. Note that there should be at least 5 cm on either side of the Plexiglass® support for unobstructed water return to the aquarium. The open cell polyurethane foam can be conveniently cut with an electric knife to the desired size and shape, including a V-trough to accommodate the fish patient.

4 The pre-soaked foam surgical platform is placed atop the Plexiglass® support, and the anesthesia delivery tube is secured to the foam. This can be accomplished with clamps or by cutting a slit in the foam and sliding the delivery tube through it.

General Considerations for Anesthesia[3]

- Food should be withheld for at least one feeding cycle prior to anesthesia.
- Fish should be handled carefully to avoid abrasions or loss of protective mucus.
- Pre-anesthetic stressors on the fish should be minimized. Relaxed fish experience a smoother induction than aroused fish.
- Covering the eyes or darkening the room can help calm a fish that is incompletely immobilized.
- During prolonged out-of-water procedures, the skin must be kept moist.
- Anesthetic effects in fish are gauged by activity, reactivity to stimuli, equilibrium, muscle tone, respiratory rate (opercular movement), and heart rate.
- Higher water temperatures accelerate rates of induction and recovery.

MS-222[3]

Tricaine methanesulfonate (MS-222, Finquel®) is the most widely used fish anesthetic and is the only one currently approved for use in food fish in the U.S. Administered as a water-borne solution, tricaine is absorbed across the gill epithelium.

Tricaine is conveniently mixed in-house as a stock solution of 10 g/L (10,000 ppm). The stock solution is unstable in light and should be kept in a dark container. Shelf life can be extended by refrigeration or freezing. Because tricaine solutions are acidic (stock solutions can be as low as pH 3), they should be buffered prior to administration to fish. Saturation with sodium bicarbonate buffers the stock solution to between pH 6.0 and 7.5.

Tricaine methanesulfonate (MS-222)

Anesthesia induction	100-200 mg/L
Maintenance	50-100 mg/L
Sedation	15-50 mg/L

Tricaine margins of safety are narrower for young fish in warm, soft water, and there is variation across species. Recovery from short procedures is rapid (less than 10 minutes if properly dosed), with prolonged recoveries (up to 6 hours) from longer procedures.

Clove Oil

A practical alternative to MS-222 is clove oil (active ingredient = eugenol), which is available at many pharmacies. Eugenol is not completely soluble in water and should be diluted 1:10 in 95% ethanol to yield a working stock solution of 100 mg/ml (each ml of clove oil contains approximately 1 g of drug). Concentrations of 40-120 mg/L are effective in freshwater and marine species. Results are comparable to MS-222, except recovery may be prolonged.

5 The tube is connected to the pump, the pump is plugged in, and the FADS is ready for operation. In continuous flow systems, the flow should be normograde (in the oral cavity and out the opercular opening) to achieve optimal gas and anesthetic exchange. Most power head pumps have adjustable flow rates. The venturi tube is used to keep fish moist.

RISK FACTOR 1 | 2 | 3 | 4 | 5

Prior knowledge of fish medicine or a willingness to investigate the literature is essential before using this device in practice.

Acknowledgement

The authors would like to thank Dr. Al Camus, Aquatic Animal Disease Diagnostic Laboratory, Louisiana State University, for his input.

Calculation Reminders

Start with a stock solution of 10 g MS-222 per L of water (10 mg/ml). If you want a drug concentration of 100 mg/L in a 10 L FADS, add 100 ml of stock solution to the FADS (a total of 1000 mg or 1 g of MS-222).

Start with clove oil stock solution (approximately 100 mg/ml). In 10 L of water, add 4 ml of clove oil stock solution to obtain a concentration of clove oil of 40 mg/L.

Further Reading

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