Humane euthanasia of fish

There are a large number of potential euthanasia techniques in fish. Some of these require drugs and equipment only available in a veterinary practice, others can be performed humanely by an owner or lay person.

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CPD

As with reptiles, following all methods of euthanasia, destruction of the central nervous system (CNS) should be performed – most commonly via pithing.

Anaesthesia is often used as part of the euthanasia technique. Signs of a surgical plane of anaesthesia are:

- Hypoventilation (respiration is almost absent)
- Loss of response to stimulation
- Loss of equilibrium
- Loss of muscle tone

Waterborne anaesthetic agents delivered in an aqueous solution are widely used. This enters the blood stream via the gills, is far more convenient and causes less distress to the fish than the administration of parenteral agents.

Euthanasia of a fish at home

RCVS regulations state euthanasia is not an act of veterinary surgery and can be performed by a suitably trained individual. With careful explanation of the required techniques, euthanasia performed at the home, can still be considered humane. In the authors' experience, however, few owners (except perhaps keen fishermen) feel comfortable performing euthanasia at home and prefer veterinary assistance.

Cranial concussion followed by decapitation, exsanguination or pithing can be performed by the client at home. Catching the fish quickly and calmly will limit any stress. The fish can then be restrained (tea towel or similar is helpful) and struck hard over the head with a heavy blunt object.

Figure 1. Carassius auratus spp being euthanised in MS222. Note the loss of equilibrium.

When performed correctly cranial concussion will cause sufficient damage to the CNS that pithing or decapitation should not be required – nonetheless, it is often recommended when a less experienced person is performing the euthanasia procedure. A sharp knife can be used to decapitate the fish or a thin knife or skewer to pith the head and spinal cord.

Cervical dislocation and/or decapitation followed by pithing is another method of euthanasia that can also be performed at home. Following restraint, you firmly pull the head away from the body to dislocate the cervical vertebrae (owner must be warned decapitation can occur), before using a sharp implement (a skewer or thin knife) to pith the head and spinal cord.

Chemical overdose is not recommended for home euthanasia, due to the difficulty with safe disposal and risks to the public when handling chemicals. Although clove oil is widely recommended as a euthanasia solution, recent guidelines produced by the American Veterinary Medical Association state that the use of clove oil is not currently deemed acceptable because adequate and appropriate clinical trials have not been performed on fish to evaluate its effects.

Euthanasia of a fish in the practice

Chemical overdose is the most commonly deployed

method of euthanasia in practice, and all practices should keep appropriate chemicals of one variety or another in stock. All veterinary practices will have a stock of volatile anaesthetic agents.

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Fluorinated hydrocarbons, such as isoflurane, halothane or sevoflurane, can be added to the fish's water to effect, by either pouring the liquid into the water and mixing well or by bubbling the vaporised compound through the water.

Use of such chemicals has the major disadvantage of being potentially hazardous to the operator, so the use of a fume cupboard, if available, is recommended.

Practices that see large numbers of exotic animals are more likely to stock tricaine methanesulfonate (MS222), which is an easy to use fish anaesthetic and euthanasia chemical (**Figure 1**). A dose rate of 300ppm to 500ppm for 15 minutes is usually sufficient for euthanasia of most fish species. MS222 should always be used as a buffered solution – sodium bicarbonate is the most readily available buffering agent. A pH monitor should be used to confirm a neutral pH (7 to 7.5) before a fish is added to the solution. A urine dip-stick can be used if a dedicated pH monitor is not available.

Special considerations are required for the disposal of MS222. The drug should be mixed with cat litter until fully absorbed and stored in a pharmaceutical waste bin. The practice's designated police officer then needs to witness its destruction, at which point the container can be sealed, labelled and sent for incineration.

Parenteral delivery of a chemical agent for euthanasia is suitable for large fish species where immersion in a chemical solution is not practical or poses too great a health and safety risk. First anaesthesia should be induced and a number of drugs are recommended; such as ketamine with or without an alpha-2-agonist, propofol, lidocaine and alfaxalone. The authors' preferred choice is an intramuscular injection of alfaxalone as it is not associated with pain on injection. Following induction of anaesthesia, pentobarbital, at a dose of 60mg/kg, can be given intravenously. A lateral or midline (**Figure 2**) approach to the caudal veins (lying ventral to the tail vertebrae) or the veins (medial aspect) on the opercula can be used (Ross, 2001). Pithing should then be performed to destroy the CNS with a needle or other sharp implement.

Figure 2. Injection of euthanasia solution into the caudal vein in a rainbow trout (Oncorhynchus mykiss). The needle is inserted in the ventral midline just caudal to the anal fin. The vein is ventral to the overlying spine.

Amphibia

Most of the same methods described for anaesthesia of fish can also be used in amphibia, prior to an injection of euthanasia solution. Immersion, with the addition of a fluorinated hydrocarbon (isoflurane, halothane or sevoflurane) at a ratio of 1:3 into the amphibian's water (if aquatic) or trickled over the skin, is most useful as the required materials are commonly found in a veterinary practice. MS222 can also be used, as in fish, with appropriate attention to buffering (**Figure 3**).

Figure 3. Immersion of a axolotl in buffered MS222 solution.

An adequate plane of anaesthesia (deep) has been reached when there is:

- Loss of the withdrawal reflex (hind toe pinch)
- Loss of righting reflex
- Absent corneal reflexes

The preferred method of euthanising amphibia is an overdose of pentobarbital via intravenous or intracardiac injection (**Figure 4**). As with reptiles, a doppler (**Figure 5**). can be used to help identify the location of the heart.

An overdose of MS222 at 200mg/kg intracoelmically is rapid and does not harm organs for pathology (Mylniczenko, 2009). As with fish, the chemical methods of euthanasia should be followed with pithing to ensure death.

Similiarly to reptiles, cooling of amphibia should *never* be used as a method of inducing anaesthesia or euthanasia; however, rapid freezing (dipping in liquid nitrogen) is approved and effective in amphibia weighing less than 40g in weight – larger species may not be rendered unconscious rapidly enough and hence this technique should *not* be used in such cases (Mader, 2006). Use of carbon dioxide is thought to be inhumane because amphibia can tolerate hypercarbia (Mylniczenko, 2009).

Invertebrates (aquatic and terrestrial)

Although not commonly presented to first opinion veterinary practice, invertebrates require ▸

specific techniques when performing humane euthanasia.

While there is still debate as to whether the sensory function of invertebrates allow them to feel pain, it is commonly appreciated that invertebrates do show a response to noxious stimuli. It is best to assume they feel pain and euthanise them in a humane manner, rather than assume otherwise and later be proved wrong. Anaesthesia should precede euthanasia.

In lower invertebrate species (such as sponges, corals, jellyfish) anaesthetic overdose may be considered appropriate alone, but in higher species such as decapod crustaceans (including shrimp and crab) pithing (destruction of nervous tissue) is considered optimal for euthanasia and ensuring death.

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Fluorinated hydrocarbons, such as isoflurane, halothane or sevoflurane, can be used effectively in most invertebrates – via an anaesthetic chamber for terrestrial species (ensure the circuit pipes are covered by gauze to prevent escape) or in water for aquatic species (use their own water particularly in marine species to minimise stress). The RSPCA (2011) cites slowly cooling as a suitable method of rendering crustacea insensible prior to death. The chilling gradient must not be more than two degrees an hour.

Figure 4. Intracardiac injection of pentobarbital in a anaesthetised pirenaica salamander.

Figure 5. Using a doppler to confirm euthanasia.

Spiders and other terrestrial invertebrates can be euthanised via pithing or immersion in a fixative such as formalin or alcohol (Pizzi, 2011), but the patient *must* be anaesthetised first. Rapid freezing (following for example immersion in liquid nitrogen) will also instigate death – however, this method results in tissue damage and so should not be used if histological examination is required. ■

CPD Questions

1. Which method would you recommend to a client as most appropriate for euthanasia of a gold fish at home?

   A. Cranial concussion

   B. Clove oil

   C. MS222

   D. Freezing

2. True or false: MS222 can be safely disposed of in a commercial drain?

   A. True

   B. False

3. What pH should MS222 solution be at prior to anaesthetising a fish?

   A. Neutral pH 7-7.4

   B. Acidic pH 4-5

   C. Alkaline pH 9-10

Answers 1.A 2.B 3.A

References

Cooper J (2011). Anaesthesia, analgesia, and euthanasia of invertebrates, ILAR J, 2011;52(2): 196-204.

Heard D, Fleming G. Lock B. and Jacobson E (2002). Lizards. In: Meredith, A. and Redrobe, S. (eds) BSAVA Manual of Exotic Pets, (4thedn), BSAVA, Cheltenham.

Johlin JM and Moreland FB (1933). Studies on the blood of the turtle after complete anoxia.

J Biol. Chem 103: 107-114.

Joslin JO (2009). Blood Collection Techniques in Exotic Small Mammals, Journal of Exotic Pet Medicine, Vol 18(2): 117–139.

Mader D (2006). Euthanasia. In: Mader, D. (ed) Reptile Medicine and Surgery. (2nd edn), Saunders Elsevier, Missouri.

Mylniczenko N (2009). Amphibians. In: Mitchell MA, Tully TA (et al). Manual of Exotic Pet Practice, St. Louis, Saunders Elsevier: 73-111.

Pizzi R (2011). Invertebrate Medicine: 2nd Edition, Lewbart GA, Wiley Blackwell, Oxford: 209

Raiti P (2002). Snakes, In: Meredith, A. and Redrobe, S. (eds) BSAVA Manual of Exotic Pets, (4thedn), BSAVA, Cheltenham.

Ross L (2001). Restraint, anaesthesia and euthanasia. In: Wildgoose, WH BSAVA Manual of Ornamental Fish, (2nd edn), BSAVA, Gloucester: 75-83.

RSPCA (2011). Humane electrical stun/killing of Crustacea. Available from: http://www.rspca.org.uk/sciencegroup/researchanimals/ethicalreview/functionstasks/housingandcare/humanekilling

The Merck veterinary Manual, 2011. Available from: http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/150500.htm&word=euthanasia

Declaration of interests:
Tom Dutton and Neil Forbes both work for the Vets Now group in Swindon.