Cyndi Brown, DVM, Column Editor

Diagnostic contrast radiography in fish

David Eshar, DVM, La'Toya Latney, DVM & Nicole R. Wyre, DVM, Dip. ABVP (Avian)

Despite the abundance of fish as research models, diagnostic techniques for fish diseases are relatively scarce. With some accommodations for handling fish, the same diagnostic tools that are frequently used for other animals can be applied in fish. This column describes indications, preparation and techniques for contrast radiography in fish.

Fish are used as models in various research studies[1]. Although there is adequate information on fish diseases, diagnostic approaches in fish are relatively limited[2–5]. Despite the minor challenges of handling fish, the same diagnostic tools that are frequently used for other animals can be applied to provide sick fish with a comparable level of medical care[3].

Abnormal buoyancy and swimming patterns are common clinical presentations of sick fish[6]. Buoyancy disorders can be secondary to a number of disease processes, including swim bladder pathology (inflammation, rupture, infection, herniation)[3], pneumonic duct obstruction or inflammation, gastrointestinal disease (foreign bodies, intestinal parasites)[7], organomegaly (renomegaly, reproductive masses), coelomic masses (abscesses, neoplasia) and skeletal pathologies[3,4,8,9]. Conventional radiography is useful in the diagnosis of swim bladder and skeletal diseases, but evaluation of the coelomic soft tissues can be limited owing to poor coelomic detail in most fish[3]. Advanced imaging procedures such as ultrasound, computed tomography and magnetic resonance imaging provide superior views of soft tissue coelomic structures but are rarely used in practice. Contrast radiography is a relatively simple, inexpensive and noninvasive diagnostic procedure that allows for better evaluation of the intracoelomic soft tissue structures[3].

Materials

Standard radiographic techniques used in other animals can also be applied to fish[4]. Digital radiography, dental radiography, intensifying film screens and detailed (mammography) film can optimize radiographic detail[3]. Placing the film cassette in a plastic bag or covering it with Plexiglas can protect it from water but also increase radiographic artifacts[3]. We prefer to keep the film dry by using a protective water bag or a paper towel to absorb any excess fluids.

Fish preparation

Before the fish is brought into the radiography suite, the room should be prepared. The X-ray machine should be set to the pre-determined kilovolt peak (kVp) and milliamp seconds (mAs), and supplemental oxygen should be available. The room should have dim lighting to prevent startling photophobic fish[3]. The fish can be extracted from the water tank either by using a fine net or manually, using moistened powder-free rubber gloves. The fish's ventrum should be carefully supported by the cup of the hands or fingers. Some larger or dangerous fish (those with barbs, spines or poisonous spines) should be handled carefully and may require chemical restraint for this technique[3].

Positioning techniques

Water bag. Small or medium-sized fish can be placed in a disposable, resealable zipper storage bag with a small amount of tank water added to submerge the fish and ensure that water is passing over the gills (**Fig. 1**). The fish can be further isolated

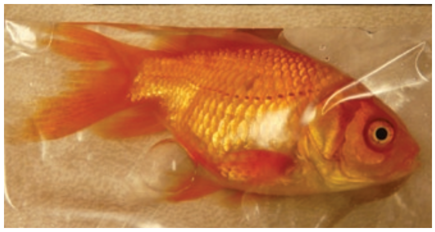

FIGURE 1 | Left lateral positioning of a fish in a plastic bag with a small amount of tank water. The bag can be placed on a radiograph cassette. This positioning method allows the fish to continue breathing (brachial ventilation) during the procedure and minimizes direct handling of the fish.

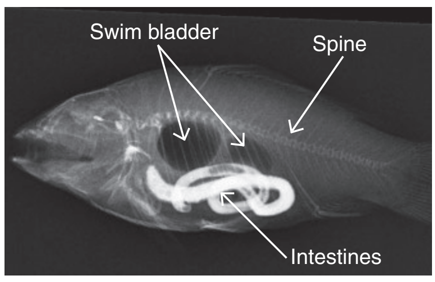

FIGURE 2 | Administration of oral contrast material such as barium sulfate or iohexol can be used to outline the gastrointestinal tract. Right lateral view of a contrast study in a fish. The arrows identify major structures easily identified on fish radiographs: the swim bladder, gastrointestinal tract and spine.

Department of Clinical Studies - Philadelphia, University of Pennsylvania, School of Veterinary Medicine, Philadelphia, PA. Correspondence should be addressed to D.E. (dreshard@gmail.com).

FIGURE 3 | Delivery of contrast material to a fish orally using a teflon-sheathed catheter (without the stylet) advanced into the oral cavity past the level of the gills. The contrast medium is carefully instilled into the stomach.

into one corner of the bag in preparation for radiography with a lateral recumbency view. If necessary, a pair of long hemostats (with the teeth covered in adhesive tape to prevent bag puncture) can be used to clamp the bag at a level that isolates the fish into one corner. This method allows the fish to continue breathing (brachial ventilation) during the procedure and minimizes direct handling of the fish. The disadvantages include reduced radiographic detail, as the beam must focus through an additional water medium, and changes in positioning with increased movement of the fish.

Moistened paper towel. This technique can be used for any size fish. The fish should be removed from the water and briefly placed on a moistened paper towel for radiography with a lateral recumbency view. This technique allows for improved radiographic detail and direct visualization of brachial ventilation. Disadvantages include direct handling, possible disruption of the stress coat layer, increased risk of hypoxia and minimized control of the fish.

Radiographic positioning

Two or three radiographic views should always be obtained to comply with basic diagnostic radiology principles[3,4]. A standardized lateral (**Fig. 2**) and dorsoventral view are the most practical and easiest to obtain, but other views can also be obtained with a horizontal beam[3]. Foam pads and sand bags can be used for proper and safe positioning of the fish[3]. A dorsoventral view can be achieved by placing water-filled gloves on both sides of the isolated fish to hold it in ventral recumbency.

Taking survey and contrast radiographs is a short procedure that can usually be done without general anesthesia or chemical restraint of the fish[3]. Speed and efficiency are essential, as most fish are quiet when initially placed on the cassette. They can be quickly radiographed before becoming hypoxic and fractious. Most fish can be safely handled outside of water for 30–50 s before severe hypoxia ensues[2]. Hypoxia begins when water is no longer flowing over the gills. The opercular movements should be closely monitored and counted. A syringe, filled with tank water, should be used to flow water over the gills if the fish is removed from the water. A recovery tank, preferably with an airstone and water temperature at the desired optimal range for the particular fish species, should be placed in the radiology room (if possible, the recovery tank should be filled with water from the fish's original tank to reduce stress). Once the procedure is done, the fish should immediately be placed back into the recovery tank, which provides a temperate, oxygen-rich environment that aids in recovery and ventilation[3].

Contrast delivery

After survey radiographs are taken and the fish seems to be stable, oral contrast material can be given. An appropriately sized red rubber catheter, stainless feeding needle or intravenous catheter (teflon-sheathed, without the stylet) can be advanced into the oral cavity past the level of the gills (**Fig. 3**). Either barium sulfate (36% suspension) or iohexol (1%) can be carefully instilled into the stomach at a dose of 5 ml per kg body weight. If size limits the safe passage of an orogastric tube, then we prefer to use iohexol, which can be safely delivered into the oral cavity using a syringe. After administration of the contrast agent, the fish should be immediately placed back into the water tank and monitored for signs of regurgitation through the oral cavity or the operculum. Radiographs can be taken immediately and at intervals of 3–4 h after contrast administration. Depending on the water temperature and the species, it may take days for the fish to empty the contrast agent from the gut[7]. Iohexol- or barium-soaked pellets may be fed to the fish, if direct oral administration of the contrast agent is not possible, although they may alter gastrointestinal transit time.

Radiographic anatomy

Although coelomic detail can be difficult to evaluate in most fish, subtle coelomic changes can be identified with contrast radiography. Knowledge of normal fish anatomy can assist in diagnosis of coelomic abnormalities[3,5]. In addition to literature resources, radiographs of normal fish with similar signalment can be used as a basis for comparison to evaluate the coelomic anatomy of different fish species[2–5,9].

Conclusion

Contrast radiography is a noninvasive and inexpensive diagnostic tool that allows for better evaluation of the soft tissue intraceolomic structures. This simple technique can greatly improve the clinical evaluation of sick fish.

1. Ostrander, G. *The Laboratory Fish* (Academic, San Diego, 2000).
2. Reavill, D.R. Common diagnostic and clinical techniques for fish. *Vet. Clin. North Am. Exotic Anim. Pract*. **9**, 223–235 (2006).
3. Love, N.E. & Lewbart, G.A. Pet fish radiography: Technique and case history reports. *Vet. Radiol. Ultrasound* **38**, 24–29 (1997).
4. Stetter, M. Diagnostic imaging and endoscopy. in *BSAVA Manual of Ornamental Fish* (Wildgoose, W.H., ed.) 103–108 (BSAVA, London, 2001).
5. Smith, S. & Smith B. Xeroradiographic and radiographic anatomy of the channel catfish, *Ictalurus punctatus*. *Vet. Radiol. Ultrasound* **35**, 384–389 (1994).
6. Hatfield, C., Whitaker, B., & Clayton, L. Emergency and critical care of fish. *Vet. Clin. North Am. Exotic Anim. Pract*. **10**, 647–675 (2007).
7. Scott, E. Gastroenterology of the piscine patient. *Vet. Clin. North Am. Exotic Anim. Pract*. **8**, 247–276 (2005).
8. Groff, J. Neoplasia in fish. *Vet. Clin. North Am. Exotic Anim. Pract*. **7**, 705–756 (2004).
9. Lewbart, G.A. *Self-Assessment Color Review of Ornamental Fish* (Iowa State University Press, Ames, IA, 1998).