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Pneumocystectomy in a Midas cichlid

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- This report illustrates the feasibility of radiography, anesthesia, and coelomic surgery in a pet fish.
- Pneumocystectomy can improve certain buoyancy disorders in fish.

A 5-year-old 800-g mature male Midas cichlid (*Cichlasoma citrinellum*)[a] was examined because of a 2-year history of a distended abdomen and inadequate buoyancy control. Water quality variables were within normal limits (pH maintained between 7.0 and 7.4, 33% of aquarium water changed weekly, and no detectable ammonia or nitrite), and the fish had been fed a mixed diet of commercially prepared sinking cichlid pellets and live earthworms. The fish swam with its head down, but continued to eat and defecate normally. The owners had raised the fish from a fry, and it had been housed alone for several years after being attacked and mutilated by a mature female Midas cichlid in the same aquarium. The swollen area in the left caudal portion of the abdomen had been aspirated by the referring veterinarian 9 months before admission. The referring veterinarian determined that the distended area was air-filled, which made the possibility of an abscess or tumor of this area less likely. Several weeks after aspiration, the swelling increased in size. At the time of our examination, the fish rested between a 90° and 120° angle to the gravel substrate at the bottom of the aquarium. The fish swam awkwardly when stimulated.

Left-to-right lateral and right lateral decubitus horizontal beam (dorsoventral) whole-body radiographic views were obtained without anesthesia (Fig 1). The fish was placed directly on a plastic covered film cassette. A single rare earth detail-intensifying screen and detail single emulsion film were used to obtain the radiographs.[b] Radiography revealed an L-shaped radiolucency in the central coelomic cavity, which was asymmetrical and larger on the left side. The radiolucency represented the swim bladder. Additional radiographic findings included kyphosis of the central region of the vertebral column, and osseous proliferation of the vertebral column from the level of the kyphosis extending caudally. Differential diagnoses for the osseous changes included bony remodeling, perhaps secondary to the previously reported trauma (with possible healed vertebral fractures or subluxation), degenerative changes such as spondylosis deformans, or, less likely, a nutritional imbalance. Multiple healing rib fractures were noticed. A clinically normal male Midas cichlid was radiographed for comparative purposes (Fig 2). Compared with the clinically normal fish, the affected fish had generalized enlargement of the swim bladder, and the left caudal component was grossly dilated. The caudal compartment septum was not detected.

To alleviate the fish's buoyancy problem, the fish was anesthetized, and a celiotomy was performed to approach the swim bladder and reduce its size. A recirculating anesthesic machine was constructed (Fig 3). A submersible pump[c] was placed in 10 L of dechlorinated tap water containing 60 mg of tricaine methanesulfonate[d]/L of water. A stock solution of tricaine methanesulfonate was prepared by dissolving 10 g in 1 L of deionized water and buffering it to pH 7.0 with sodium bicarbonate. A separate 10-L aquarium containing clean water without anesthetic was placed next to the anesthetic reservoir. This made it possible to quickly dilute the anesthetic concentration if the fish became too deeply anesthetized. The surgical area was located 1 m above the pump and the 10-L aquariums. A 10-L plastic tub was the drainage and collecting vessel for water on the surgical table. This tub was drained by a 5-cm flexible tube that returned water to the 10-L reservoir below it. Anesthetic water was pumped from a 5-cm flexible tube that was fitted with a T adapter. Two 2-cm delivery tubes were attached to the T adapter and placed in the mouth of the fish so that water bathed both sets of gills.

Anesthesia was induced by immersing the fish in a solution containing 100 mg of tricaine methanesulfonate/L of water, for 6 minutes. An additional 50 mg of tricaine methanesulfonate/L of water was added to the aquarium. After 2 minutes, the fish had only mild opercular movements (the opercula could be observed moving, but the motion was not sufficient to generate water flow across the gills). The fish was placed in dorsal recumbency on the V-shaped foam trough, and the delivery tubes were positioned in its mouth. Anesthesia was maintained with tricaine methanesulfonate (60 mg/L) at a constant flow rate of 2 L/min. Total duration of anesthesia was 71 minutes, and the fish was kept moist by "basting" it every few minutes with water from a 60-ml syringe. The fish was given enrofloxacin (10 mg/kg of body weight, IP) prior to surgery to reduce the possibility of a secondary bacterial infection. The scales were removed from the area of the planned incision site with forceps. A midline ventral abdominal incision was begun immediately caudal to the base of the pectoral fins and extended caudally. The incision curved laterally approximately 2 cm cranial to the cloacal opening and ended lateral to the cloacal opening. Small self-retaining retractors were placed to spread the incision edges. The abdominal viscera were retracted cranially. The dorsal abdominal musculature was incised to access the swim bladder. The caudal aspect of the swim bladder was carefully dissected free from its attachments to the body wall. After an encircling ligature of 4-0 nylon suture material was placed, the caudal end (approx 5 × 2 × 2 cm) of the swim bladder was excised. The dorsal abdominal

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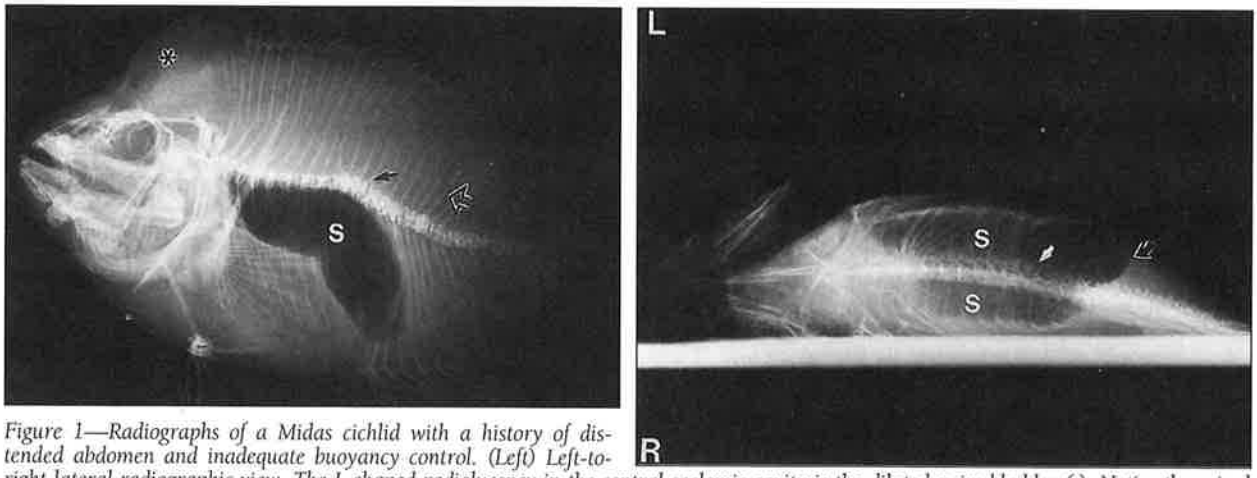


Figure 1—Radiographs of a Midas cichlid with a history of distended abdomen and inadequate buoyancy control. (Left) Left-to-right lateral radiographic view. The L-shaped radiolucency in the central coelomic cavity is the dilated swim bladder (s). Notice the spinal kyphosis and bony proliferative changes involving the vertebral column (black arrow) and multiple healing chronic rib fractures (open arrow). The soft-tissue opacity (*) dorsal to the orbit is a normal finding. (Right) Dorsoventral radiographic view of fish in right lateral recumbency obtained by use of a horizontal beam. Notice the asymmetric radiolucent swim bladder (s), which extends more caudally on the left (curved arrow), and bony proliferative changes of the vertebral column (white arrow).

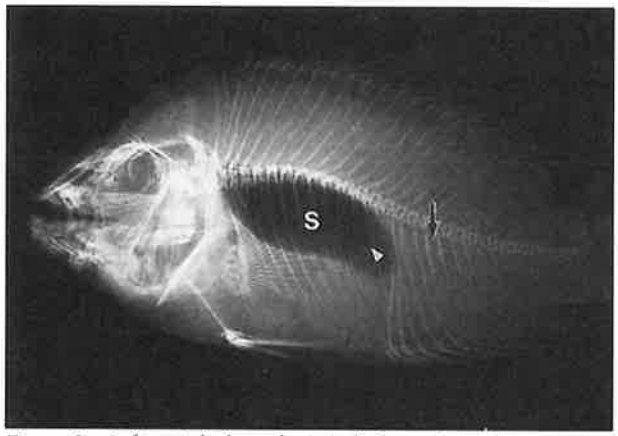
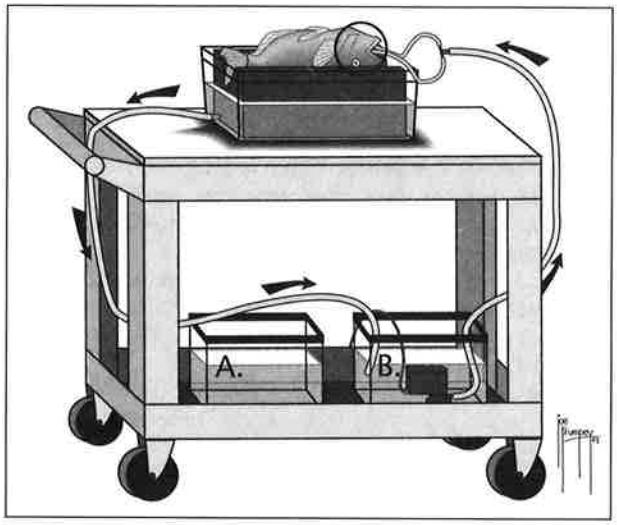


Figure 2—Left-to-right lateral whole body radiographic view of a clinically normal Midas cichlid. The swim bladder (s) lacks the L-shape that the fish in Figure 1 has, and encompasses less overall coelomic space. Notice the caudal compartment septum (white arrowhead). Two chronic rib fractures are seen (black arrow).



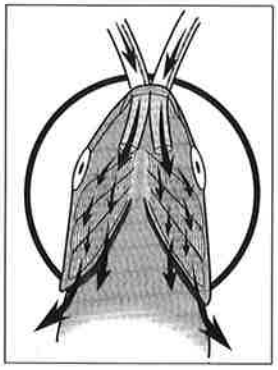


Figure 3—(Above) Illustration of the anesthetic machine with submersible pump in tank B, which contains the anesthetic, and tank A, which is not in the recirculating system, but could be quickly used by removing the pump from tank B and placing it in tank A. Arrows indicate water flow, which is controlled by regulating the diameter of the outflow tube that drains the operating area. (Right) Illustration of how the water enters the mouth and is directed over the gills located deep to the opercula (gill plates).

musculature was approximated with 4-0 polyglactin 910.[e] The ventral abdominal incision was closed with simple interrupted 4-0 polyglactin 910 sutures in the musculature and the subcuticular layers and 4-0 nylon sutures in the skin.

The fish recovered without complication from the anesthesia and surgical procedure, but refused food in the days following surgery. Five days after the surgery, it began to float abnormally again. There was mild swelling of the left caudal portion of the abdomen, and 35 ml of air was aspirated from the swim bladder by use of a 23-gauge butterfly catheter. When air could no longer be aspirated, the needle was removed from the fish. Following this procedure, the fish began to eat and was able to maintain normal posture at the bottom of the aquarium. Sixteen days later, the fish was swimming at a 45° angle from the bottom. Again air was aspirated (36 ml) from the swim bladder, and the fish resumed a normal posture in the aquarium. The surgical incision appeared inflamed at this time. The skin sutures were removed, and the inflammation subsided. The fish appeared normal for 18 days before again having a buoyancy problem. A referring veterinarian removed 35 ml of air from the swim bladder. Five days later, we again examined the fish because of a buoyancy problem. Radiographs were obtained before and after 35 ml of air was aspirated from the swim bladder. The fish did require air aspiration approximately 6 months after the surgery, when it was positively buoyant, with normal cranial-to-caudal attitude. Air was again aspirated 6 months later, and at

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the time of this writing, the fish has been clinically normal in a negatively buoyant state for 11 months.

The swim bladder is an anatomic structure in many species of fishes, and it may have 1 or more functions, including buoyancy control, respiration, sensation, and sound production.[1-4] Midas cichlids and other members of the cichlid family are physoclists. Fishes in this category regulate the amount of gas in their swim bladders by using 1 or more countercurrent capillary beds (retia mirabilia), which are located in the wall of the swim bladder. Gases are exchanged by simple diffusion between the vascular rete and the swim bladder lumen, where the partial pressure of a particular gas exceeds the partial pressure of that gas in the bloodstream.[1]

Buoyancy problems in captive fishes are common. Causes include subcutaneous air accumulation caused by supersaturation of the water with atmospheric air or gases from deep underground water sources, infection or rupture of the swim bladder, gastroenteritis, and equilibrium disorders related to inner ear disease. The cause of the swim bladder disorder in the fish of this report was not determined. Bacteriologic culturing was not performed, because a buoyancy problem caused by bacterial disease was considered unlikely. A developmental anomaly could not be ruled out, but was unlikely because the buoyancy problem did not become evident until the fish was an adult. Trauma inflicted by the tankmate could have damaged the swim bladder's gas-producing or gas-absorbing rete mirabile. Histologic evaluation of the excised portion of the swim bladder revealed mild, diffuse, granulocytic infiltrate; however, this finding was not believed to be important, because of its mild nature.

Reduction of the volume of the swim bladder improved the fish's ability to maintain a normal posture in the aquarium. Accumulation of air in the weeks following surgery could have been caused by small amounts of air leaking from the healing swim bladder. Subsequent aspiration seems to have prevented further accumulation of air. It is possible that the fish's condition could have been managed without surgery by performing frequent aspiration of air in the swim bladder; however, this would have been a chronic stress on the fish and a hardship for the owners. The surgery did reduce the size of the swim bladder and, in the instances when more air did accumulate, the fish's buoyancy problem was never as severe as it was at the time of admission. If the fish has further buoyancy problems, a second surgery may be indicated to remove more of the swim bladder.

Tricaine methanesulfonate is an FDA-approved and widely used anesthetic for fishes.[5] Most fish experience an excitatory stage of anesthesia followed by sedation, a loss of equilibrium, and finally a loss of reactivity. It is desirable to maintain an anesthetic plane at this level. Mild opercular movements should be maintained, and the gills must be bathed sufficiently with water containing anesthetic. Anesthetic effects of tricaine methanesulfonate are quickly reversed by placing the fish into a solution of fresh, clean water.

[a]The Midas cichlid also is commonly known as the red devil cichlid in the pet fish industry.

[b]Kodak Lanex Fine Screen and Kodak M EM-1 Film, Eastman Kodak Co, Rochester, NY.

[c]AquaClear 402 Powerhead, Rolf C Hagen Corp, Mansfield, Mass.

[d]Finquel, Argent Chemical Laboratories, Redmond, Wash.

[e]Ethicon Inc, Somerville, NJ.

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