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Selected research and dramatic surgery fish cases of incisive complete in fish surgical

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Abstract: Health problems which can be treated exclusively by surgical means are relatively uncommon in fish. Fish surgery feat is vital essential and inevitable for the at fish diseases treatment and fish recovery. Consequently, only a limited number of procedures have been developed and reported in the literature. Despite use of analogous surgical instruments and surgical techniques to those employed in other animals, fish are a very diverse taxon and specific anatomy and physiology should be reviewed before surgical procedures are performed. Surgical planning often requires advanced diagnostics such as ultrasonography and imaging. Essential surgical procedures include cutaneous and intracoelomic mass excision, ophthalmic procedures, reproductive surgery, brain surgery, visceral organs surgery, gastrointestinal foreign body removal, visceral organs examples, and buoyancy concerns. This article reviews several surgical procedures that have been performed in fish and highlight various aspects of surgical care which relate specifically to fishes. In this review article, administration of sedation and anesthesia, anaesthetic agents, pain in fish, obtrusive fish cases surgery, fish cases surgery operations examples, frequently used anesthetics and preoperative considerations, underwater surgery, out of water surgery, specific surgery procedures, microsurgery techniques, laparoscopy, catheter implantation and laparotomy were discussed for fish researchers. Suggestions for appropriate postoperative management are also discussed.

Keywords: Fish surgery; fish surgical procedures; fish cases; dramatic cases of fish surgery; surgery instruments; anesthesia

1 Introduction

General considerations: although the notion of fish surgery is often greeted with skepticism, fish can make excellent subjects for surgery. Fish surgeries take place in both research and clinical settings. The decision to proceed to surgery in clinical cases can be motivated by the rarity of the species involved, the economic value of the patient, or the owner's emotional attachment to the fish. In the authors' experience with fish-owning clients, fish are certainly not exempt from the human-animal bond. An excellent description of fish surgery for veterinarians has been published previously and an extensive basic review of fish anesthesia and surgical techniques has been written for fish researchers lacking prior surgical experience (Craig and Gregory 2000). Surgery of fish is an exciting and pioneering field for veterinary practitioners (Loh and Chia 2016).

After anesthesia is administered, specific surgical procedures can be performed on fish, including laceration and fin tear repairs, biopsies, celiotomy, liver biopsy, renal biopsy, laparoscopy, mass removals, resection of prolapsed intestines, fracture repair, and abdominal surgery to remove impactions and tumors (Murray 2002).

General surgical knowledge and experience will facilitate successful fish surgery, as will familiarity with normal fish anatomy. Frequently, these are surgeries for external skin or fin tumor excisions and abdominal exploratory surgeries to remove masses or biopsy organs. Other surgical procedures have been performed for repair of lacerations from traumatic injuries, resection of prolapsed cloacal tissues, and orthopedic procedures on fish with spinal fractures (Saint-Erne 2015).

Specific surgical procedures have been performed on fish, including laceration and fin repairs, biopsies, celiotomy, laparoscopy, mass removals, resection of prolapsed intestines, fracture repair, and abdominal surgery to remove impactions and tumors (Murray 2002). Very important incisive surgical operations such as tumor removal (Reid and Backma 1988), gallbladder catheterization in pharmacokinetic studies (Sohlberg et al. 1997), prosthetic eye operation (Mentalfloss 2016), monitoring of heart rate during operations (Saint-Erne 2015) have taken place in the literature.

This review article aims to draw attention to fish surgery for success when surgical intervention is needed, to explain successful fish surgeries, and to encourage the development of a fish operating room in the laboratory to protect the survival rights of fish (natural or cultured fish), which is one of the valuable parts of nature, and to increase their survival.

2 Underwater Surgery and Out of Water Surgery

Main advantage of the underwater surgery type is that it caters to the water needs of patient fish. However wound contamination and osmotic tissue damage, the rippling surface caused by movement in the water and the presence of escaped blood usually obscures the field of view (Wildgoose, 2000). Most surgery on fish is performed out of the water by surgeons. Only brief procedures lasting less than four minutes are manageable without anesthetic delivery system to provide a low maintenance dose of anesthetic and fresh oxygenated water. The lack of reflexes that can be fish may necessitate the use of either an electrocardiograph or a doppler pulse ultrasound probe, particularly during prolonged anaesthesia. Body moist by periodic irrigation of the skin to avoid desiccation of the delicate tissues (Wildgoose 2000).

3 Anesthesia

Anesthesia is an essential tool in the detailed live fish examination. For surgical operation, fish must be tranquilized and anesthetized. Tranquilization is enough for different manipulations such as immobilization, prolonged transport, and facial lesions treatment. Although more complex surgical operations require general anesthesia (Yıldırım et al. 2009).

Commonly utilized chemicals for anesthesia and tranquilization are as follows. MS-222 (3-Aminobenzoic Acid Ethyl Ester), Benzocaine (Ethyl p-Aminobenzoate), Quinaldine Sulfate (2-Methylquinoline Sulfate), Carbon Dioxide (CO_2), Tricaine Methane Sulfonate, Diazepam (Valium), Ethanol (Ethyl Alcohol), Ether (Dimethyl Ether), Eugenol/Isoeugenol (Clove Oil), Isoflurane (1- Chloro- 2, 2, 2- Trifluoroethyldifluoromethyl Ether), Ketamine Hydrochloride, Propofol (2, 6- Diisopropylphenol) (Bowser 2001; Neiffer and Stamper 2009; Saint-Erne 2010; Loh 2012).

According to the principle of modern anesthesiology, anesthetic drugs are not used alone. While reaching the desired level of an anesthesia, the use of anesthetic alone is quite risky. Muscle relaxants such as diazepam, tubocurarine chloride, pancuronium bromide, atropine, xylazine are used to decrease the emergency of anesthesia in fish. This prevents excitation or delirium, rigidity, and respiratory depression (Mattson and Riple 1989).

4 Preoperative Surgical Preparation

The goals of doctor the patient's surgical and anesthetic perioperative mortality and to return him to desirable functioning. It is imperative to realize that "perioperative" risk is multifactorial, the invasiveness of the surgical procedure, and the type of anesthetic administered (Zambouri 2007). Stop fish feeding for a certain period time before the time of surgery. Clean possibly the area to be operated on.

Before the surgical operation, the anamnesis of sick fish should be taken and the case scenario should be investigated in detail. Surgical preparation should not destruction of mucus just because these are majority safety fences to complications, potential risks, contamination and infection.

Infections are prevented by using a protective dose of antibiotics before the operation. It is recommended to continue antibiotic administration for 1 to 4 weeks at the end of the operation (ceftazidime 30 mg/kg) (ScottWeber et al. 2009; Filik 2020).

5 Surgery Instruments

Essential surgery instruments for fish surgery are ophthalmic or microsurgery instruments due to size. In addition many surgeries can be performed with a scalpel, magnifying lens, iris scissors, Metzenbaum scissors, mosquito hemostats, hemostatic forceps and other surgical accessories (Saint-Erne 2015). Commonly used in laboratory, the ocular or microsurgical pack is warranted for fishes (Harms et al. 1995). Head loupe magnification with center mounted illumination helps visualize structures that are small in coelomic cavity. Gelpi or Weitlander retractors for large fish and self-retaining ocular retractors for small fish visceral organs (Craig 2005). Start the incision cranial to vent and continue forward to pectoral fin bones, as needed. Scales along incision may be cut through or removed with forceps before making an incision. Use gentle blunt dissection with the hemostats, Metzenbaum scissors, or gloved fingers to isolate the desired tissues. Ligate blood vessels as needed with 2-0 or smaller absorbable suture material such as Vicryl or Maxon. Stainless steel Hemoclips may also be used for ligation. Bipolar cautery units are useful for small vessel hemostasis (Saint-Erne 2015).

6 Fish Surgery: Postoperative Care and Common Procedures

Surgical operations in fish are also applied in cases of vaccine, organ biopsy, removal of problematic organs and tumors, removal of other pathological and nonpathological tissue, blood collection, drug injection, implant placement, marking, sperm and egg retrieval (Yıldırım et al. 2009). During the surgical operation, and all the environment, surgical instruments while performing the surgical operation must be sterile.

Surgical arae is cleaned with a 1:10 diluted solution of 1% povidone-iodine in 0.9% physiological saline. Small dabs of petroleum jelly will help it adhere to the skin (Saint-Erne 2015).

Scale injuries can also be repaired if the sloughed scale still contains adequate attached epidermis, and is immediate. Clean skin via iodine solution. Remove sutures in a few days, or when the tissue has reattached. Skin and fin wounds can be sutured using fine monofilament nylon sutures. To repair lancinated and injured fin membranes, gently scrape the opposing edges scar tissue, and then tightly oppose the fin edges with a continuous suture pattern. Incorporate fin rays in each side to keep suture from tearing through the fin membrane and topical disinfectant solution apply (Saint-Erne 2015).

Surgeries are practical for clinical and researches in fish. Certain surgery adjustments are necessary to accommodate piscine tissue handling, skin sensitivity, aqueous respiration, anatomic variations, and patient size. Surgerys successfully carried out include celiotomy aciurgy, enucleation, pseudobranchectomy aciurgy, swim bladder surgery, gonadectomy aciurgy, vascular catheterization, visceral organs biopsy techniques, and telemetry device implantation, (Craig and Gregory 2000).

Successful abdominal surgeries have been performed to remove both testicular and ovarian gonadal tumors. These appear as large irregular, fibrous masses in the caudal abdomen. Abdomen to appear quite distended. Following may removal, survey abdominal organs and contralateral gonad to assess any damage. In some cases, fish's gas bladder will become traumatized and distended, creating an appearance similar to an abdominal tumor. An ultrasound, radiograph, and endoscopy (Weber et al. 2009) examination will distinguish between an enlarged gas bladder. The damaged compartment of the gas bladder was isolated. The cranial compartment when removed is ligated at the isthmus. Fish will stabilize its buoyancy with the remaining portion of the gas bladder (Saint-Erne 2015).

A 25 cm Cyclosoma labiatum was presented because of a large growth present on the caudoventral aspect of the dorsal fin. The tumor was approximately eight cm3, hyperemic around its periphery, and well-embedded in the fin. Anesthesia was performed using tricaine methanesulphonate (TMS). Ventral recumbency with the surgical site maintained out of the water. The mass was removed using standard tumor excision techniques. Thermal cautery was used to seal the excision site and prevent electrolyte loss. The fish recovered uneventfully in a separate oxygenated tank and was then transferred to a convalescent tank containing 0.5% NaCl solution for one week (Reid and Backman 1988).

During the surgery procedure, an electrocardiogram (ECG) reading is taken to monitor the heart rate and rhythm. Three ECG lead clips can each be attached to the metal part of 22-gauge hypodermic needles. These needles then are placed through the skin and right pectoral fin (RA lead), left pectoral fin (LA lead), and cranial to the vent opening (LL lead). The P-QRS-T waves produced are of low amplitude (1 mV QRS complex). Heart rates are temperature dependent. Typical heart rates are 40 beats per minute but can range from 15 to 100 beats per minute. Increase freshwater flow across to lessen anesthesia and cause pulse to increase if it slows too much (Saint-Erne 2015).

After surgery, place fish in aerated non-anesthetized water of the same temperature in recovery with dusky lighting, in a quiet area (Saint-Erne 2015). Adhesion (Filik 2019) of biofilm (Bülbül and Filik 2019; Filik 2020) to different material surfaces is a serious problem. For this reason, postoperative follow-up biofilm prevent for the implant material placed during implant surgery.

Post-surgical butorphanol can be administered to control pain at 0.1–0.4 mg/kg IM. Tube feed fish food made into gruel in a blender if fish is not eating by after surgery. Surgical success depends on adequate surgical correction of the serious problem, bacterial prevention, bacterial virulence distruption (Nurcan, 2010), good hemostasis, and proper incision closure (Saint-Erne 2015).

7 Surgical Technique

Primarily and as immutable rule the surgeon should keep all the skin moist throughout the surgical procedure, taking care to avoid irrigating the incision site with anesthesia water. Presoaking the opencell foam V-tray. Due to there is no linea alba, so necessitating a carefully controlled entry into the coelomic cavity to intestinal damage. The body wall is poorly pliable, unless the coelomic cavity is distended. Adequate retraction with self-retaining retractors helps the surgeon maintain coelomic visualization despite the rigid body wall. Organs are not freely mobile, so surgeons must perform manipulations within the coelomic cavity rather than exteriorizing the organs (Craig 2005).

Suture materials are use successful at healing time and tissue reactivity (Gilliland 1994), it seems that monofilament sutures such as polydioxanone or polyglyconate are preferable to multifilament sutures such as silk, chromic gut, polyglactin 910, probably partly because of the ability of multifilament from the surrounding water (Sohlberg et al. 1997).

Needles with a cutting tip facilitate skin penetration. The use of continuous Ford interlocking patterns, simple continuous, simple interrupted, simple incision and horizontal mattress for skin closure has had success and satisfactory results. Continuous patterns have the advantages of reducing drag, minimizing knot surface area available for epibiont colonization, and reducing surgery time, but may be more prone to loosening if adequate tension is not maintained through the entire line and if knots at either end are not secure. Single or two-layer closure is usable depending on the thickness of the body wall; skin and fins is the strength layer of the closure. The subcutaneous layer is minimal, with dermis tightly adhered to the underlying muscle, thus there is barely any dead space and any necrotic focus to eliminate. Ideally, one should remove skin sutures when the incision is recovered, usually in a few weeks in uncomplicated cases. The removal of sutures eliminates a possibility of inflammation and can speed the final stages of incision recovering.

Use of cyanoacrylate tissue adhesive for incision closure, either in combination with sutures or alone, may be problematic in fish. However, they also show some inconvenient characteristics, such as less resistance to toxicity and tension in some sick fish. Also at surgery, cyanoacrylate can causes severe dermatitis in fish (Stoskopf 1993), and when used alone is associated with a higher incidence of incision dehiscence (Petering and Johnson 1991). Irritancied goblet cells rapidly produce mucus and elevate the tissue glue layer away from the skin. When tissue adhesives are used in addition to sutures, the sutures retain the cyanoacrylate with mucus trapped beneath, and the loose glue creates extra drag on the sutures. In spite of tissue adhesive is sometimes advocated to seal the suture line and make it watertight, an appropriately sutured incision suffices to prevent water incursion, and re-epithelialization is rapid in fish. Researchers and fish surgeons have used surgical staples successfully in fish after operation; these could theoretically reduce skin closure time compared with suturing (Summerfelt and Smith 1990). Many fish surgeons reported surgical staples influentially at skin closure.

In neurological studies involving ablation of specific nervous system targets 2% agar gel in physiological saline (Weltzien et al. 2003; Merriam-Webster 2022) or vaseline-paraffin oil capped with anchored vinyl polysiloxane impression material (Zottoli et al. 2021) have been in use to seal and fill the tissue void in fish (Craig 2005).

Wound closure and anchoring of bio-loggers. Two separate thin nonabsorbable (5–0) suturations were used to anchor loggers (red arrow). The logger was abdominal cavity by tapering end pointing towards the pericardial layer. Both suture needles were loggers and then tied knot logger. Using two anchor sutures give flexibility to place loggers close to the pericardial body cavity and traumatonesis is determined. In Test 1, same thin 5–0 non-absorbable sutures were also used for wound closure (black arrow). In Tests 2 & 3 surgical wound was closed using relatively thick 3–0 non-absorbable sutures whereas same thin 5–0 suture as above used for anchoring the loggers. Fish gills were irrigated with seawater containing MS222 at a dose of 20 mg.l-1 during the surgery (Yousaf et al. 2022).

8 Selected Research and Incisive Cases of Fish Surgery in Fish Surgıcal Procedures

An opercular approach. Researchers have developed a unique surgical model for diabetes mellitus in fish, in which the pancreatic endocrine cells are contained solely in an easily excised single mesentery-bound organ adjacent to the hepatic portal vein, separate from the exocrine pancreatic tissue scattered diffusely throughout the mesenteries (Kelley 1993). Fish reproductive organs are elongated and require a correspondingly long incision for surgical removal. The primary blood supply lies at the cranial pole of the gonad, and caution is also necessary at the caudal pole to avoid damage to the excretory systems (Cloud 2003). Endoscopic techniques have approved useful and success for biopsy of entrail organs (Murray et al. 1998). Catheterization of the dorsal aorta is a well-known procedure for repeated blood sampling without complications (Lo et al. 2003). The apparatus for catheterizing the dorsal aorta all involve placement of a catheter into the dorsal aorta at the confluence of branchial vessels in the roof of the mouth. Connecting tubing then exits dorsally through the nasal bone, with anchors placed strategically intraorally and externally along the dorsum of the fish to prevent the catheter from dislodging if the extension tubing becomes entangled (Sohlberg et al., 1997) and intracoelomic catheterization for delivery of drugs in pharmacokinetics studies (Craig 2005).

The goldfish was threatened by a dangerous case of constipation, and the only way to save its life was by surgery to remove the impaction. Anesthetized the fish and carefully removed a lump from its rectum, and another from its dorsal fin. The constipation surgery on the three-inch fish took 50 minutes and was completely successful. A rockfish was being bullied by other fish because it has only one eye. The researcher thought a prosthetic eye might trick the other fish into thinking the rockfish had both eyes. The researcher stitched a bright yellow fake eye onto the rockfish under aseptic conditions and hence has been realized a prosthetıc eye surgery. A goldfish was born without a lower jaw. This meant he couldn’t keep his mouth constantly open like a normal goldfish, and he struggled to breathe and eat. Fashioned a tiny plastic splint for a prosthetıc jaw surgery and stitched the sterile splint to the bottom of the fish mouth (Mentalfloss 2016).

9 Analgesia

Analgesia is the absence of sensation of pain without loss of consciousness, loss of pain. Depending on the procedure, post-operative analgesia may be necessary. A selection of medicines includes: Meloxicam at 0.1-0.2 mg/kg IM, Flunixin 0.25–0.5 mg/kg IM, Carprofen 2-4 mg/kg IM, Morphine 0.1-0.3 mg/kg IM, Methadone 0.1–0.3 mg/kg IM, Butorphanol 0.1-0.4 mg/kg IM (Loh and Chia 2016).

10 Recovery

To regain consciousness, drug-free water is passed over the gills until spontaneous ventilation returns. Fish may then be returned to clean water to recover unassisted until they are free swimming (Loh and Chia 2016).

11 Fish Autopsy

An autopsy is the most essantial piece at Fish medicine. An autopsy (postmortem examination, obduction, necropsy, or autopsia) is a surgical procedure that consists of a thorough examination of a died fish by dissection to determine the cause, mode, and manner of death or to evaluate any disease or injury. Autopsies are unremarkably conducted by a specialized doctor (Khoroshailo and Gvozdeva 2022; Filik and Filik 2022).

12 Euthanasia

Euthanasia is ending a fish's life by giving a painless or minimally painful lethal injection, administering a high dose of medication, or disconnecting the person from life support because their life is perceived as unbearable (Ferreira et al. 2022).

13 Discussion and Conclusion

The dolphin named "Winter" with a prosthetic tail at the Clearwater Aquarium in Florida, USA, became the world's first bionic sea creature. Winter's tail was severed when she was two months old when she got caught in a Crab trap. Winter, with a 75-centimeter tail made of silicone and plastic, can swim easily. Winter, a bottlenose dolphin that lives in the Atlantic Ocean, was near death when she was rescued from the trap in 2006. "I felt so sorry for Winter. It took me a year and a half to build the tail. We worked hard to get Winter to move her tail in all directions," said Kevin Carroll, the world's leading prosthodontist, who has also implanted artificial organs in dogs and an ostrich (Carroll 2008; Brooks 2018). Fish surgery is advancing day by day. This recent successful operation is an example of this.

In that study, the researcher added an undetermined concentration of the antibiotic kanamycin to the water for an undetermined time period; the author did not address survival and wound healing, but a enough number of fish survived a few weeks after surgery for the aims of the study. Products such as Orabase gel (Garcia et al. 2022) or extracellular matrix protein may be suitable for sealing and promoting healing of surgical defects in fish when such defects are not amenable to suturing (Craig 2005).

Post-surgery can also serious a series of problems. For this reason, it is vital to follow up on the sick fish after the surgery. All sensitivity during the operation should be maintained after the operation. As the number of sick fishes increases, so too will the indications for surgical intervention. In general, the most difficult aspect of fish surgery is the provision of safe and adequate anesthesia. In this sense, several different anesthetic regimens are provided. Once one is familiar with the normal anatomy of the piscine patient, the basic concepts of surgery prevail, including appropriate surgical approach, hemostasis, and gentle tissue manipulation. Common specific surgical procedures in fish include integumentary mass excision, intracoelomic mass removals, reproductive system procedures, gastrointestinal foreign body removal, ocular procedures, celiotomy, liver biopsy, renal biopsy, and laparoscopy and radio-transmitter implantation. With the right medicines and equipment, surgery on fish is within the scope of traditional veterinary practice. Finally, the successful outcome of surgical manipulation often rests in the postoperative management of the surgical patient fish.

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