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The Influence of Topical Antibiotic Application on growth and Survival of Hybrid Striped Bass Surgically Implanted with Dummy Ultrasonic Transmitters

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ABSTRACT

Ultrasonic telemetry allows fisheries management biologists to evaluate habitat use and movement patterns of fish. The physical condition of the fish is altered by surgical tag implantation into the body cavity, and many studies have been conducted to quantify effects on fish behavior and health following surgery. However, few studies have evaluated whether topical antibiotic application to the incision site minimizes long-term effects associated with recovery following surgery. Therefore, we quantified how common surgical procedures coupled with a topical antibiotic affected growth and survival of hybrid striped bass (*Morone chrysops * Morone saxatilis*). Growth and survival were assessed over an eight week period among four treatment groups: 1) control/no surgery, 2) sham surgery, 3) surgical tag implantation, or 4) surgical tag implantation with a waterproof topical antibiotic; all reared in a controlled environment. Growth did not differ among treatments; however, survival differed with 100% survival occurring in the control and the tag plus topical antibiotic treatments. In surgical treatments without topical antibiotic use, survival was 95% with sham surgery and 85% with surgery plus tag. Inflammation was reduced at the incision site when the waterproof topical antibiotic was used. Ultimately, these data suggest application of topical antibiotics may increase survival and thus reduce biases associated with mortality during telemetry studies.

Keywords: hybrid striped bass, topical antibiotic, telemetry, transmitter.

INTRODUCTION

Telemetry tools allow fisheries management biologists to remotely monitor fish movement and provide an increased understanding of fish ecology and behavior. These techniques have become common and have dramatically advanced fisheries science. Telemetry studies have been conducted on both lentic and lotic fishes, and are commonly employed to assess habitat use (Paukert and Willis 2002), daily movement (Helfman et al. 1983), and migration patterns (Carmichael et al. 1998). Although telemetry provides useful information, deleterious effects on fish health or altered behavioral patterns may arise following implanting or attaching transmitters, thus rendering the movement data and efforts associated with collecting these data (i.e., manual tracking) unusable. Most fishery scientists are cognizant of the potential drawbacks and attempt to be minimally invasive with current surgical implantation techniques.

Methods of transmitter implantation or attachment have been extensively studied in order to minimize the effects on fish behavior and health. Surgically-implanted transmitters are recommended (Bridger and Booth 2003), as they have fewer effects on behavior and growth than external attachment (Adams et al. 1998). Many studies have been conducted to quantify the effects of suture materials and patterns, surgeon experience, and recovery environment on fish health and behavior (Ross and McCormick 1981; Wagner et al. 2000; Cooke et al. 2003). Overall, these studies suggest influences on fish health or behavior are minimized when environmental conditions are below the thermal optima (e.g., desired temperature for growth and survival), and when experienced surgeons implant transmitters and suture the incision site (Ross and McCormick 1981; Wagner et al. 2000; Cooke et al. 2003).

Few investigators used topical antibiotics; although therapeutic techniques may facilitate the healing process (Summerfelt and Smith 1990). Some studies suggest a lack of benefit associated with theraputents (Hart and Summerfelt 1975; Wagner et al. 1999), but Summerfelt and Smith (1990) noted further evaluations of topical disinfectants were warranted. In the current study, we monitored growth and survival of hybrid striped bass (*Morone chrysops * Morone saxatilis*) reared in a controlled environment following surgical tag implantation using a topical antibiotic treatment. We predicted that waterproof topical antibiotic may reduce the probability of infection at the surgical site, speed healing, and ultimately reduce effects of tag implantation on survival and growth.

METHODS

Seven hybrid striped bass (Keo Fish Farm, Keo, AR) of similar size (484 g ± 15.0; mean ± standard error) and age were stocked into each tank (940 L) of a recirculating aquaculture system at Southern Illinois University (Carbondale, Illinois) comprised of 12 raceways (N = 84 fish). The fish were acclimated to laboratory conditions (24 h photoperiod, constant 20° C water temperature, and continual system maintenance) over a 2-week period prior to the experiment. These fish were fed an extruded diet manufactured by Nelson & Sons (Murray, UT) that met all known nutritional requirements for hybrid striped bass (Gatlin 1997). Fish were fed daily to apparent satiation throughout the trial with the exceptions of 24 h prior to initial experimentation and final weigh out, when feed was withheld before each event.

Throughout the experiment, water quality was monitored daily and kept within optimal growth conditions for hybrid striped bass (Kohler 2000). Dissolved oxygen and temperature were monitored using a YSI model 550 oxygen meter (Yellow Springs Instruments, Yellow Springs, Ohio), while ammonia-nitrogen (NH_3-N) and nitrite-ni-

trogen (NO_2-N) were monitored using a spectrophotometer (Model DR/2010, Hach Company, Loveland, CO). Total alkalinity (mg/L $CaCO_3$) was monitored daily using a sulfuric acid titration kit (Hach Company, Loveland, CO). Water volume in all tanks was maintained using internal standpipes, with excess water flowing through common drainage. The water then passed through a sand filter via water pumps to remove suspended solids and through partially submerged biological filters before returning to the experimental raceways.

Triplicate tanks of hybrid striped bass were subjected to the following randomly assigned treatments: 1) control/no surgery (NS), 2) sham surgery (SS), 3) surgical tag implantation (STI), or 4) surgical tag implantation and a topical waterproof antibiotic treatment (STI+Anti). Prior to surgery, all instruments and dummy transmitters (non-functioning transmitter made from epoxy acrylic, 6g, 10x36 mm; not exceeding 2-3% of body weight) were disinfected using 95% alcohol. Aseptic conditions were attempted to be maintained, given surgeries were performed in a non-sterile environment.

Prior to surgery, hybrid striped bass were anesthetized using MS-222 (~100 ppm) buffered with sodium bicarbonate (~100 ppm). Fish were considered anesthetized once equilibrium was lost and swimming ability ceased. Fish were then placed onto a clean V-shaped surgery board, and water was circulated over the gills. In all treatments (including NS), the incision area was disinfected with a 10% povidone-iodine solution. For treatments SS, STI, and STI+Anti, incisions were made by two experienced surgeons (Sara J. Tripp and Michael J. Hill >1000 fish surgeries combined experience) ventral to the lateral line and anterior to the anal opening. A scalpel and curved hemostats were used to lift tissues while cutting to avoid damage to internal organs, and three or four Ethicon 3-0 monofilament sutures were evenly placed to close the incision site. Sutures were closed with a simple interrupted technique, deemed the strongest and most suitable for closing the skin of fish (Summerfelt and Smith 1990). In STI and STI+Anti treatments, the sterilized transmitter was inserted into the abdominal cavity and maneuvered anterior to the incision to avoid pressure on the sutures. After implantation, the incision was closed with three or four closely spaced sutures. In our topical antibiotic treatment, we swabbed on an over-the-counter, human oral antibiotic rinse (Rincinol™, GUM, Chicago, IL) to completely cover (thin layer and the same amount on each fish) the incision site. All fish were immediately transferred back into their respective treatment tank for recovery. Fish were monitored daily during the experiment to determine mortality. Two-weeks post surgery, all fish were anesthetized and the incision site of each was photographed. Photographs were used to evaluate healing qualitatively. At the conclusion of the experiment (8 weeks post-surgery), all fish were euthanized, weighed to the nearest g to determine growth (percent increase; ((weight-final-weightinitial)) / weight initial * 100), and incision site was again photographed.

Statistical Analyses

Growth and survival responses of fish were subjected to one-way analysis of variance (ANOVA) using the general linear model of the Statistical Analysis System version 9.1 software (SAS Institute Inc. 2002, Cary, North Carolina). When a significant treatment effect was detected, Tukey's HSD test was utilized to determine where the differences existed. All statistical comparisons were maintained at α of 0.05.

RESULTS

All fish recovered from the anesthetic within a few minutes. No mortalities occurred within the first 48 h post-surgery. Furthermore, fish began feeding within 48 h post surgery and only 1 fish from the STI treatment group expelled their tag over the course of the evaluation. Growth did not significantly differ among treatments ($F_{3,8}$ = 0.17, P = 0.91). Growth of the hybrid striped bass ranged from 12.75% in the NS group to 16.41% in STI treatment (Fig. 1). However, survival differed among treatments ($F_{3,8}$ = 8.00, P < 0.01; Fig.1). Survival of the hybrid striped bass ranged from 85% in the STI to 100% among NS and STI+Anti treatments. Mortality was randomly distributed among replicates within treatments, indicating that experimental tank conditions had minimal effects on survival. Qualitatively we also noted that reduced inflammation was observed in STI + Anti treatment compared to fish in the SS in STI treatments (Fig. 2).

DISCUSSION

Biotelemetry is a valid and necessary method used by fisheries management biologists to observe freshwater fish and understand behavior. To date, the use of surgically implanted transmitters to obtain habitat use or movement information of fishes is a widely accepted and suggested method (Statsko and Pincock 1977; Bridger and Booth 2003). However, most studies suggest tagging procedures are stressful and may impair normal behavior and because of this, many have evaluated various techniques to reduce stress and ensure tagged fish behave similarly to untagged individuals. In addition, therapeutic techniques may facilitate the healing process (Summerfelt and Smith 1990), ensuring normal behavior. However, the few studies that have evaluated topical therapeutants suggest a lack of benefit (Hart and Summerfelt 1975; Wagner et al. 1999).

Contrary to other studies (Hart and Summerfelt 1975; Wagner et al. 1999), we have

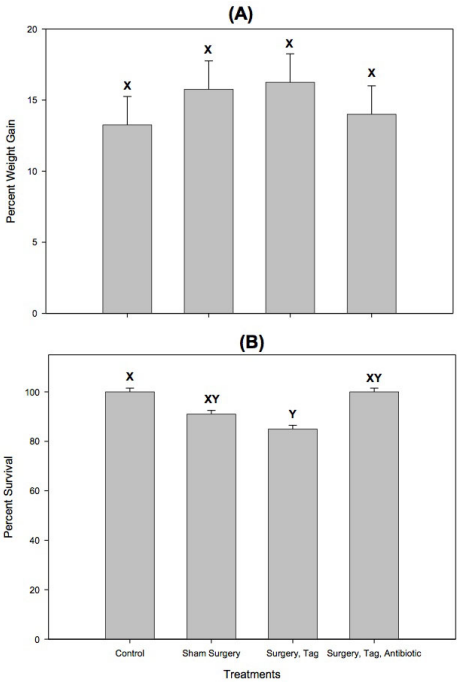

Figure 1. Weight gain (Panel A; mean ± standard error;) and survival (Panel B) of control, sham surgery, surgical tag implantation, and surgical tag implantation with topical waterproof antibiotic treatments. Different letters above vertical bars represent statistically different means for each treatment.

Figure 2. Illustrative examples of control, sham surgery, surgical tag implantation, and surgical tag implantation with a topical waterproof antibiotic fish at two and eight weeks post surgery.

shown that using a waterproof topical antibiotic (i.e., rincinol) may increase survival of implanted hybrid striped bass. Based on our qualitative analyses, topical antibiotic treatment of the STI+Anti fish appeared to have decreased inflammation at the incision site (Figure 2) and may have reduced infection resulting in higher survival among this treatment. We believe the antibiotic likely increased protection of the wound site, reduced susceptibility to bacterial colonization or infection, and promoted healing. Development of necrotic tissue at the incision enhances the probability of tag expulsion in adult bluegill (Knights and Lasee 1996) and hybrid striped bass (Walsh et al. 2000). Therefore, the use of an antibiotic may reduce production of necrotic tissue and result in higher tag retention rates. This study was conducted in an experimental setting, and the product used as a topical antibiotic is not approved by the Food and Drug Administration Center for Veterinary Medicine for use in food fish or fish that are released into the wild and may be consumed. However, our results suggest that the availability of an approved product for these purposes may be useful in the context of tag implantation studies.

We have shown there are potential benefits of using a topical antibiotic on survival of implanted hybrid striped bass. However, caution must be taken when interpreting our results, because we had low sample sizes (21 fish per treatment group) and very few fish died during the experiment across treatments (i.e., there may not be biological differences between 85% survival in our surgery and tag treatment in comparison to 100% survival in surgery, tag, and topical antibiotic treatment) . Future studies should evaluate the effects of topical antibiotics on growth, survival, and behavior of surgically implanted hybrid striped bass in natural environments (e.g., ponds, reservoirs, lakes, or rivers). We also suggest future studies should be conducted on a broader range of fishes to determine if the utility of a topical antibiotic persists across species in both freshwater and marine environments.

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