Endocrine Regulation of Two Sturgeon Pituitary Gonadotropins in *Acipenser Transmontanus*

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CHAPTER ONE

BACKGROUND AND LITERATURE REVIEW

CHAPTER TWO

INFLUENCE OF ACUTE EXOGENOUS TESTOSTERONE TREATMENT ON TWO STURGEON GONADOTROPINS IN JUVENILE *ACIPENSER TRANSMONTANUS*

ABSTRACT

To determine if acute exogenous testosterone affects the synthesis and/or secretion of two sturgeon gonadotropins (stGTH I and stGTH II), juvenile white sturgeon (*Acipenser transmontanus*) were implanted intraperitoneally (IP) with silastic tubing containing 75 mg of crystalline testosterone. In fish (n=7 for all groups) sacrificed 21 days post-implantation, the pituitary concentrations of stGTH I (5.063 μg/mg protein) and stGTH II (0.935 μg/mg protein) were significantly elevated ($p < 0.01$) compared to controls (1.797, 0.261 μg/mg protein, respectively) and sham-operated animals (1.933, 0.312 μg/mg protein, respectively). Exogenous testosterone had no effect on plasma concentrations of either stGTH. Additional testosterone treated fish (n=7) which were injected IP with 10 μg/kg of the gonadotropin releasing hormone analog D-Ala^{6}-des-Gly^{10}-GnRH ethylamide (GnRHa) 21 days post-implantation also showed no increase in plasma concentrations of either stGTH. Pituitary stGTH I (4.044 μg/mg protein) and stGTH II (0.723 μg/mg protein) were significantly elevated ($p < 0.01$) in these testosterone treated fish compared to controls (1.726, 0.329 μg/mg protein, respectively) and sham-operated animals (1.803, 0.245 μg/mg protein, respectively). It appears that exogenous testosterone has a positive effect on the accumulation of stGTHs in the pituitaries of juvenile white sturgeon. However, GnRHa is ineffective in stimulating the secretion of these accumulated pituitary stGTHs.

CHAPTER THREE

THE EFFECT OF CHRONIC TESTOSTERONE ADMINISTRATION ON STURGEON GONADOTROPINS IN JUVENILE AND PRE-VITELLOGENIC WHITE STURGEON (*Acipenser transmontanus*)

ABSTRACT

The effects of chronic exogenous testosterone treatment on the synthesis and/or secretion of two sturgeon gonadotropins (stGTH I and stGTH II) were assessed in two year-old juvenile white sturgeon (*Acipenser transmontanus*) surgically implanted with silastic capsules filled with 75 mg of testosterone and in pre-vitellogenic female white sturgeon females implanted with 150 mg of testosterone. In groups of juvenile white sturgeon sacrificed 30, 60, 90, or 442 days post-implantation, pituitary concentrations of stGTH I were significantly greater in testosterone treated fish ($p < 0.01$) when compared to controls. Pituitary concentrations of stGTH II were significantly higher ($p < 0.01$) in juvenile fish treated 60, 90, or 442 days with testosterone when compared to controls. Exogenous testosterone had no effect on plasma concentrations of either stGTH. Additional testosterone treated juvenile sturgeon which were injected intraperitoneally (IP) 90 or 442 days post-implantation with 10 μg/kg of the gonadotropin releasing hormone analog D-Ala^{6}-des-Gly^{10}-GnRH ethylamide (GnRHa) also showed no change in plasma concentrations of stGTHs. Similar results were obtained for pre-vitellogenic white sturgeon, as pituitary concentrations of stGTH I and stGTH II were significantly greater ($p < 0.01$) after 60 days of testosterone treatment compared to controls. A second group of 60-day testosterone-treated pre-vitellogenic females also failed to exhibit increases of plasma stGTHs when administered 10 μg/kg of GnRHa. These results indicate that long-term testosterone treatment stimulates the accumulation of pituitary stGTHs in both juvenile and pre-vitellogenic white sturgeon but does not affect basal or GnRHa-induced stGTH secretion.

CHAPTER FOUR

DOPAMINERGIC INHIBITION OF GnRHa-INDUCED GONADOTROPIN SECRETION IN WHITE STURGEON (*Acipenser transmontanus*)

ABSTRACT

To assess the effects of dopamine on the secretion of two sturgeon gonadotropins (stGTH I and stGTH II), sexually mature male white sturgeon (*Acipenser transmontanus*) were given intraperitoneal injections of physiological saline (PS), dopamine (100 mg/kg), the gonadotropin releasing hormone analog D-Ala^{6}-des-Gly^{10}-GnRH ethylamide (GnRHa) (10 μg/kg), and a combination of GnRHa and dopamine. Fish receiving only GnRHa had significantly higher ($p < 0.01$) concentrations of plasma stGTH I and stGTH II compared to fish receiving PS, dopamine, or a combination of GnRHa and dopamine. Two hours following its administration, dopamine was effective in decreasing plasma concentrations of both stGTHs that were previously elevated by GnRHa. Dopamine or PS administered by themselves did not alter plasma concentrations of either stGTH. These results are similar to those previously obtained in several species of modern teleost fish, but represent the first evidence of dopaminergic inhibition of GnRH-induced pituitary gonadotropin secretion in Chondrostean fish.

CHAPTER FIVE

THE EFFECTS OF REPRODUCTIVE DEVELOPMENT AND SEASON ON PIMOZIDE MODULATION OF GnRHa-INDUCED GONADOTROPIN SECRETION IN *ACIPENSER TRANSMONTANUS*

ABSTRACT

The effects of the dopamine antagonist pimozide on the secretion of two sturgeon gonadotropins (stGTH I and stGTH II) in mature male white sturgeon and pre-vitellogenic females were evaluated. Spermiating males injected intraperitoneally with a combination of the gonadotropin releasing hormone analog D-Ala^{6}-des-Gly^{10}-GnRH ethylamide (GnRHa) and pimozide had significantly higher ($p < 0.01$) concentrations of plasma stGTH I and stGTH II compared to males receiving GnRHa or pimozide alone. These results confirm earlier findings in spermiating males which showed dopamine to inhibit GnRHa-induced stGTH secretion. While this effect of GnRHa + pimozide was observed in the spring, no such potentiation was seen in these fish during the summer. Using the same procedures as for spermiating male sturgeon, pre-vitellogenic females administered GnRHa, pimozide, or a combination of GnRHa and pimozide did not display any significant increases in plasma stGTHs. Why pre-vitellogenic females fail to release stGTHs in response to GnRHa and/or pimozide similar to spermiating male sturgeon is not known at this time.

CHAPTER SIX

EFFECTS OF TESTOSTERONE IMPLANTATION AND GnRHa / PIMOZIDE TREATMENT ON PITUITARY GONADOTROPINS IN PRE-VITELLOGENIC WHITE STURGEON (*ACIPENSER TRANSMONTANUS*)

ABSTRACT

Reproductive development in cultured female white sturgeon (*Acipenser transmontanus*) often becomes arrested at the pre-vitellogenic stage. To determine if hormonal treatment could induce the release of two sturgeon gonadotropins (stGTH I and stGTH II) and stimulate subsequent sexual maturation, pre-vitellogenic females were subjected to the combined effects of testosterone, the gonadotropin releasing hormone analog D-Ala^{6}-des-Gly^{10}-GnRH ethylamide (GnRHa), and the anti-dopaminergic agent pimozide. At the start of the experiment (day 0) and also 90 days later, sturgeon were surgically implanted intraperitoneally (IP) with silastic capsules containing 150 mg of testosterone or with empty pieces of silastic tubing (controls). At 120 days from the start of the experiment, both control and testosterone-treated animals given an IP injection of GnRHa failed to secrete stGTHs from the pituitary. At day 180, combined injections of GnRHa and pimozide also did not stimulate the release of stGTHs in both control and testosterone-implanted groups. Histological analysis of ovarian samples collected at days 0, 90, and 180 did not show any observable signs of ovarian development from the pre-vitellogenic to the vitellogenic stage. Pituitaries collected from testosterone-treated groups had significantly higher concentrations of stGTHs compared to controls. Despite these pituitary stGTHs concentrations resembling levels normally observed during the late stages of vitellogenesis, the reasons why this accumulated pool of stGTHs will not be released remains a mystery.