Endocrinology of Fish

MS I (Semester-II)

Maj/Zoo-S-406

Lecture – 05

Gonads

HPG Axis

- Hypothalamus regulates synthesis and release of gonadotropins through multiple neurohormones.
- Potentially other hormones such as

aminobutyric acid (GABA), pituitary adenylate cyclase-activating peptide (PACAP), norepinephrine, neuropeptide Y , serotonin, secretoneurin, ghrelin, leptin, and glutamate

- Dopamine has negative effect

HPG Axis

- Hormones associated with growth and metabolism (IGF-1, glutamate, leptin, and ghrelin)
- It signifies a relationship between reproduction, energy reserves, and body mass of the fish

HPG Axis

- In response to GnRH, pituitary release two hormones:

1- FSH (GTH I)

2- LH (GTH II)

HPG Axis

- GnRH increases the amounts of mRNA encoding gonadotropin subunits
- The response of the gonadotropin subunit mRNAs to GnRH in fish is differential and depends on the gender and reproductive stage.
- In maturing salmonids, GnRH elevates pituitary mRNAs encoding for GPα (glycoprotein) and FSH α, but not that of LH α.

Types of GnRH

- Three forms of GnRH present in the brain of gilthead seabream and Nile tilapia:

1. sbGnRH = GnRH1
2. cGnRHII = GnRH2
3. sGnRH = GnRH3

Types of GnRH

- All have LH-stimulating activity in mature females.
- However, the form most abundant in the pituitary of mature fish, GnRH1, is the least potent in inducing LH release.

GTH

- Receptors
- Two distinct receptors occur in fish gonads: the FSH-R and the LH-R.
- Expression is differential (sex and developmental stage)
- FSH-R (receptors) not only show a preference for FSH but also respond to LH, whereas LH-Rs specifically respond to LH only

GTH

- In female, FSH-R is associated predominantly with vitellogenesis and in the recruitment of new oocyte generation
- while the LH-R is prevalent during oocyte maturation and ovulation
- In males, FSH-R expression in Sertoli cells
- FSH-R is expressed in the interstitial Leydig cells too, together with LH-R.
- Expression of LH-R in males is consistently correlated with spermiation and spawning.

HPG Axis in Male

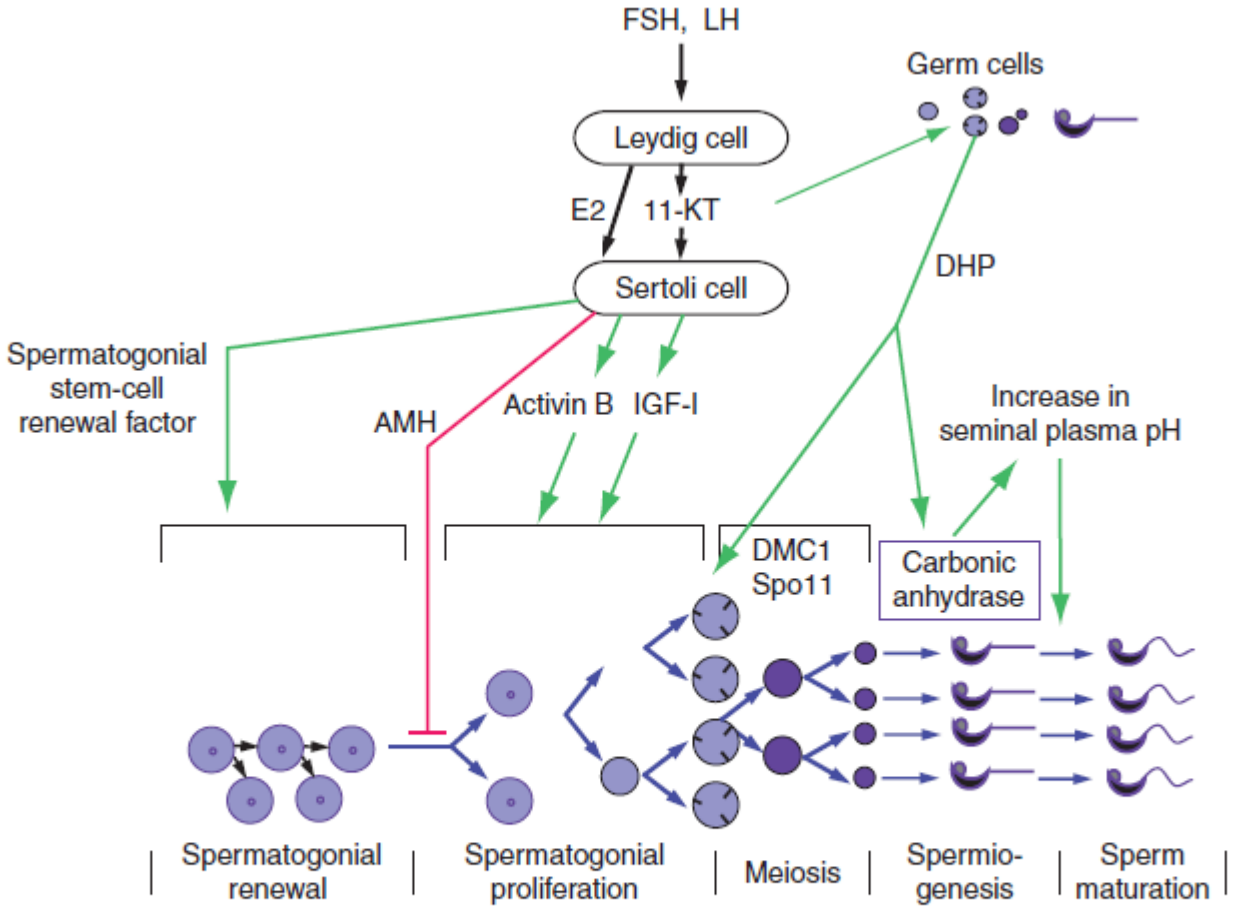

Figure 3 Endocrine mechanisms regulating spermatogenesis in the Japanese eel (*Anguilla japonica*). 11-KT, 11-ketotestosterone; AMH, a peptide homologous to anti-Müllerian hormone; DHP, 17α,20β-dihydroxy-4-pregnen-3-one; DMC1 and Spo11, markers specific to early phases of meiosis; IGF-I, insulin-like growth factor I. Cells at the upper right corner depict the germ cells as the source of DHP acting upon themselves in a paracrine or autocrine manner. Modified from Miura T and Miura C (2001) Japanese eel: Model for analysis of spermatogenesis. *Zoological Science* 18: 1055–1063 and from Miura T and Miura C (2003) Molecular control mechanisms of

HPG Axis in Female

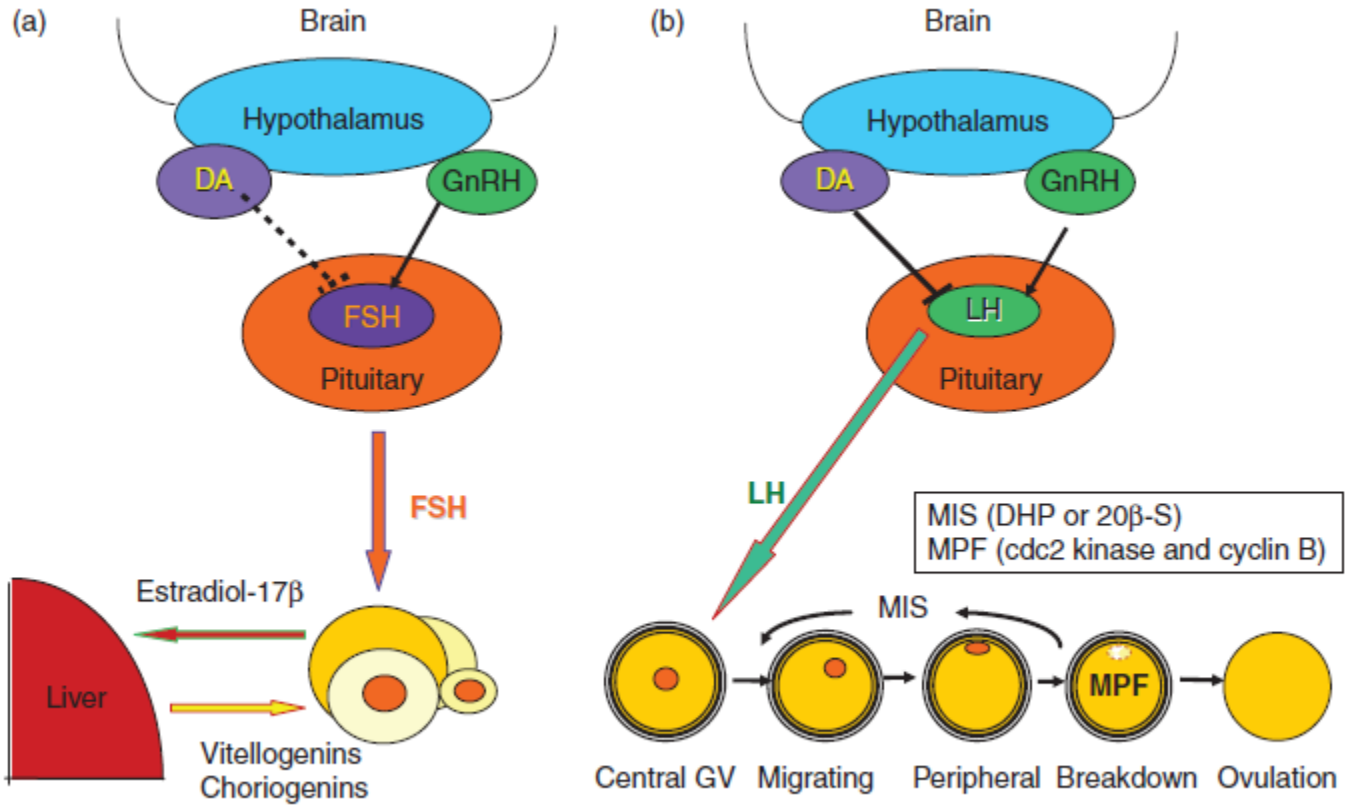

Figure 1 (a) An overview of the endocrine chain, brain–pituitary–gonadal axis (BPG axis) in model female fish during the vitellogenic phase. (b) An overview of the BPG axis during final oocyte maturation and ovulation.