

Prepared by – Dr Shuchismita Behera

Assistant Professor in Zoology

Zoology UG Fourth Semester, Core -8, Unit -2

## Hypothalamo-hypophysial axis

Hypothalamo-hypophysial axis means the connecting portion between hypothalamus and both anterior and posterior pituitary which consists of nerve fibers, blood vessels, neurons. This portion or axis controls and releases various hormones which regulate all metabolic and physiological activities of the body.

Hypothalamo-hypophysial axis is divided into 4 parts:

The hypothalamic–pituitary–adrenal axis

The hypothalamic–pituitary–thyroid axis (HPT axis)

The hypothalamic–pituitary–gonadal axis (HPG axis)

Hypothalamic–neurohypophysial system — these are the four major neuroendocrine systems.

### 1. The hypothalamic–pituitary–adrenal axis

The hypothalamic–pituitary–adrenal axis (HPA axis or HTPA axis) is a complex set of direct influences and feedback interactions among three components: the hypothalamus, the pituitary gland (a pea-shaped structure located below the thalamus), and the adrenal (also called “suprarenal”) glands (small, conical organs on top of the kidney).

### 2. The hypothalamic–pituitary–thyroid axis

(HPT axis for short, a.k.a. thyroid homeostasis or thyrotropic feedback control) is part of the neuroendocrine system responsible for the regulation of metabolism and also responds to stress.

As its name suggests, it depends upon the hypothalamus, the pituitary gland, and the thyroid gland.

The hypothalamus senses low circulating levels of thyroid hormone (Triiodothyronine (T3) and Thyroxine (T4)) and responds by releasing thyrotropin-releasing hormone (TRH). The TRH stimulates the anterior pituitary to produce thyroid-stimulating hormone (TSH).

The TSH, in turn, stimulates the thyroid to produce thyroid hormone until levels in the blood return to normal. Thyroid hormone exerts negative feedback control over the hypothalamus as well as anterior pituitary, thus controlling the release of both TRH from hypothalamus and TSH from anterior pituitary gland.

The HPA, HPG, and HPT axes are three pathways in which the hypothalamus and pituitary direct neuroendocrine function.

**3. The hypothalamic–pituitary–gonadal axis (HPG axis):** refers to the hypothalamus, pituitary gland, and gonadal glands as if these individual endocrine glands were a single entity. Because these glands often act in concert, physiologists and endocrinologists find it convenient and descriptive to speak of them as a single system.

The axis controls development, reproduction, and aging in animals. Gonadotropin-releasing hormone (GnRH) is secreted from the hypothalamus by GnRH-expressing neurons. The anterior portion of the pituitary gland produces luteinizing hormone (LH) and follicle-stimulating hormone (FSH), and the gonads produce estrogen and testosterone.

In oviparous organisms (e.g. fish, reptiles, amphibians, birds), the HPG axis is commonly referred to as the hypothalamus-pituitary-gonadal-liver axis (HPGL-axis) in females. Many egg-yolk and chorionic proteins are synthesized heterologously in the liver, which are necessary for oocyte growth and development. Examples of such necessary liver proteins are vitellogenin and choriogenin.

### **Location and regulation**

HPG regulation in males, with the inhibin/activin system playing a similar role on GnRH-producing cells.

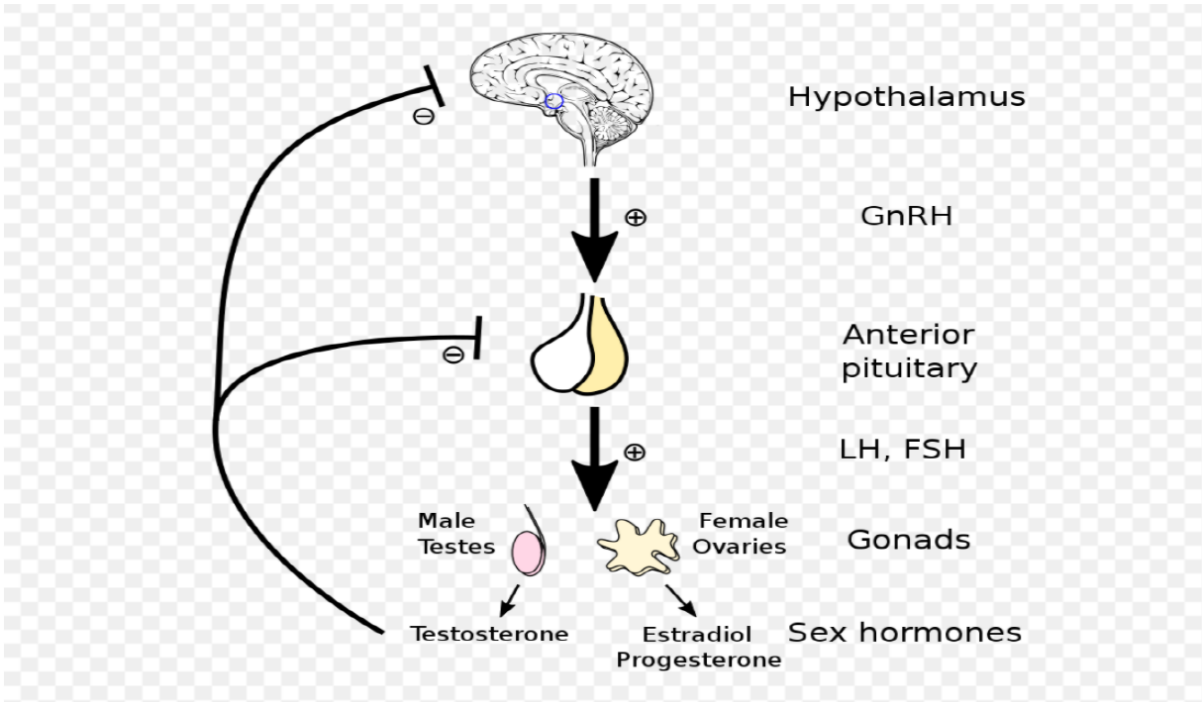
The hypothalamus is located in the brain and secretes GnRH. GnRH travels down the anterior portion of the pituitary via the hypophyseal portal system and binds to receptors on the secretory cells of the adenohypophysis. In response to GnRH stimulation these cells produce LH and FSH, which travel into the bloodstream.

These two hormones play an important role in communicating to the gonads. In females FSH and LH act primarily to activate the ovaries to produce estrogen and inhibin and to regulate the menstrual cycle and ovarian cycle. Estrogen forms a negative feedback loop by inhibiting the production of GnRH in the hypothalamus.

### **Function: Reproduction**

One of the most important functions of the HPG axis is to regulate reproduction by controlling the uterine and ovarian cycles. In females, the positive feedback loop between estrogen and luteinizing hormone helps to prepare the follicle in the ovary and the uterus for ovulation and implantation. When the egg is released, the empty follicle sac begins to produce progesterone to inhibit the hypothalamus and the anterior pituitary, thus stopping the estrogen-LH positive feedback loop. If conception occurs, the placenta will take over the secretion of progesterone; therefore, the mother cannot ovulate again.

If conception does not occur, decreasing excretion of progesterone will allow the hypothalamus to restart secretion of GnRH. These hormone levels also control the uterine (menstrual) cycle causing the proliferation phase in preparation for ovulation, the secretory phase after ovulation, and menstruation when conception does not occur. The activation of the HPG axis in both males and females during puberty also causes individuals to acquire secondary sex characteristics.



The hypothalamic-pituitary-gonadal axis (HPG axis)

Dr Shuchismita Bera