HYPOTHALAMUS
Master Gland

A region of the forebrain that regulates body temperature, some metabolic processes and governs the autonomic nervous system.

Organ ♂️ Male & Female

About Hypothalamus

Function

The hypothalamus acts as an endocrine organ as it synthesizes hormones and transports them along axons to the posterior pituitary gland. The hypothalamus also synthesizes and secretes regulatory hormones (statins and liberins) that control the endocrine cells in the anterior pituitary gland. In addition, it contains autonomic centers that control endocrine cells in the adrenal medulla via neuronal control. The hypothalamus is highly interconnected with other parts of the central nervous system, in particular the brainstem and its reticular formation. As part of the limbic system, it has connections to other limbic structures including the amygdala and septum, and is also connected with areas of the autonomous nervous system.

The hypothalamus coordinates many hormonal and behavioral circadian rhythms, complex patterns of neuroendocrine outputs, complex homeostatic mechanisms, and important behaviors. The hypothalamus must, therefore, respond to many different signals, some of which generated externally and some internally. Delta wave signaling arising either in the thalamus or in the cortex influences the secretion of releasing hormones; GHRH (growth hormone-releasing hormone) and prolactin are stimulated whilst TRH (thyrotropin-releasing hormone) is inhibited.

The hypothalamus is responsive to:

- light: day length and photoperiod for regulating circadian and seasonal rhythms olfactory stimuli, including pheromones
- steroids, including gonadal steroids and corticosteroids
- neurally transmitted information arising in particular from the heart, the stomach, and the reproductive tract
- autonomic inputs
- blood-borne stimuli, including leptin, ghrelin, angiotensin, insulin, pituitary hormones, cytokines, plasma concentrations of glucose and osmolality etc.
- stress
- invading microorganisms by increasing body temperature, resetting the body's thermostat upward.

Via the pituitary gland it controls the following body processes:

- growth
- blood pressure
- some aspects of pregnancy and childbirth including stimulation of uterine contractions during childbirth
- breast milk production
- sex organ functions in both males and females
- sexual behavior
- thyroid gland function
- hunger, satiety + the conversion of food into energy (metabolism)
- water and osmolality regulation in the body
- water balance via the control of reabsorption of water by the kidneys
- temperature regulation
- pain relief
- circadian rhythms
- sleeping patterns

**Responsiveness to ovarian steroids**

Other striking functional dimorphisms are in the behavioral responses to ovarian steroids of the adult. Males and females respond to ovarian steroids in different ways, partly because the expression of estrogen-sensitive neurons in the hypothalamus is sexually dimorphic; i.e., estrogen receptors are expressed in different sets of neurons (Pic. 1).

Estrogen and progesterone can influence gene expression in particular neurons or induce changes in cell membrane potential and kinase activation, leading to diverse non-genomic cellular functions. Estrogen and progesterone bind to their cognate nuclear hormone receptors, which translocate to the cell nucleus and interact with regions of DNA known as hormone response elements (HREs) or get tethered to another transcription factor’s binding site. Estrogen receptor (ER) has been shown to transactivate other transcription factors in this manner, despite the absence of an estrogen response element (ERE) in the proximal promoter region of the gene. In general, ERs and progesterone receptors (PRs) are gene activators, with increased mRNA (messenger RNA) and subsequent protein synthesis following hormone exposure. Male and female brains differ in the distribution of estrogen receptors, and this difference is an irreversible consequence of neonatal steroid exposure. Estrogen receptors (and progesterone receptors) are found mainly in neurons in the anterior and mediobasal hypothalamus.

**Development**

In neonatal life, gonadal steroids influence the development of the neuroendocrine hypothalamus. For instance, they determine the ability of women to exhibit a normal reproductive cycle, and of men and women to display appropriate reproductive behaviors in adult life.

Within the brain, testosterone is aromatized to (estradiol), which is the principal active hormone for developmental influences. The human testis secretes high levels of testosterone from about week 8 of fetal life until 5–6 months after birth, a process that appears to underlie the male phenotype. Estrogen from the maternal circulation is relatively ineffective, partly because of the high circulating levels of steroid-binding proteins in pregnancy.

**Anatomical structure**

The hypothalamus is located below the thalamus, just above the brainstem and it forms part of the limbic system.

The hypothalamus is a relatively small area (4 cm 3) laying between the diencephalon, commissura anterior and corpora Mammillaria (Pic. 2), forming the lower part of the walls and floor of the third brain chamber. Observed from the ventral area, it is the area between (and above), chiasm opticum and corpora Mammillaria. In the middle of this area, there is a bump called tuber cinereum from which infundibulum of the pituitary gland suspended. In humans the hypothalamus is the size of an almond.

The hypothalamus is a brain structure composed of distinct nuclei and less anatomically distinct areas. It can be roughly divided to anterior (preoptic, medial, lateral), tuberal (medial, lateral), posterior (medial, latera) part.

**Histological structure**

In human magnocellular neurosecretory cells in the paraventricular nucleus and the supraoptic nucleus of the hypothalamus produce oxytocin and vasopressin. These hormones are released into the blood in the posterior pituitary. Much smaller parvocellular neurosecretory cells, neurons of the paraventricular nucleus, release corticotropin-releasing hormone and other hormones into the hypophyseal portal system, where these hormones diffuse to the anterior pituitary.

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**Find more about related issues**

**Diagnoses**

**Amenorrhoea**

The absence of a menstrual period in women of reproductive age.

Learn more at: [www.fertilitypedia.org/therapy/diag/amenorrhoea](http://www.fertilitypedia.org/therapy/diag/amenorrhoea)
Anorexia Nervosa
An eating disorder characterized by the maintenance of a body weight below average, fear of gaining weight, and a distorted body image. Learn more at: www.fertilypedia.org/therapy/diag/anorexia-nervosa

Anovulation
Failure of the ovaries to release an oocyte over a period of time generally exceeding 3 months. Learn more at: www.fertilypedia.org/therapy/diag/anovulation

Azoospermia
Complete absence of sperm in the ejaculate of a man. Learn more at: www.fertilypedia.org/therapy/diag/azoospermia

Erectile dysfunction
The inability (that lasts more than 6 months) to develop or maintain an erection of the penis during sexual activity. Learn more at: www.fertilypedia.org/therapy/diag/erectile-dysfunction

Hyperprolactinemia
The presence of abnormally high levels of prolactin in the blood. Learn more at: www.fertilypedia.org/therapy/diag/hyperprolactinemia

Hypogonadism
A medical term which describes a diminished functional activity of the gonads – the testes and ovaries. Learn more at: www.fertilypedia.org/therapy/diag/hypogonadism

Hypopituitarism
Partial or complete loss of production of one or more of the pituitary gland hormones. Learn more at: www.fertilypedia.org/therapy/diag/hypopituitarism

Kallmann syndrome
A genetic condition where the primary symptom is a failure to start puberty or a failure to fully complete puberty. Learn more at: www.fertilypedia.org/therapy/diag/kallmann-syndrome

Klinefelter syndrome
The set of symptoms that result from two or more X chromosome in males. Learn more at: www.fertilypedia.org/therapy/diag/klinefelter-syndrome

Menopause
The time in most women’s lives when menstrual periods stop permanently, and the woman is no longer able to have children. Learn more at: www.fertilypedia.org/therapy/diag/menopause

Menstrual cycle disorders
An abnormal condition in a woman’s menstrual cycle. Learn more at: www.fertilypedia.org/therapy/diag/menstrual-cycle-disorders

Non-obstructive azoospermia
Complete absence of sperm in the ejaculate due to testicular failure. Learn more at: www.fertilypedia.org/therapy/diag/non-obstructive-azoospermia

Oligozoospermia
Semen with a low concentration of sperm and is a common finding in male infertility. Learn more at: www.fertilypedia.org/therapy/diag/oligozoospermia
Testicular failure
The inability of the testicles to produce sperm or testosterone.
Learn more at: www.fertilitypedia.org/therapy/diag/testicular-failure

Thyroid disorders
A medical condition impairing the function of the thyroid.
Learn more at: www.fertilitypedia.org/therapy/diag/thyroid-disorders

Undescended testes
In the case of cryptorchidism one or both testes are absent from the scrotum. It is the most common etiologic factor of azoospermia in the adult.
Learn more at: www.fertilitypedia.org/therapy/diag/undescended-testes

Biological control

Gonadotropin-releasing hormone
A releasing hormone responsible for the release of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) from the anterior pituitary.
Learn more at: www.fertilitypedia.org/edu/biological-control/gonadotropin-releasing-hormone

Symptoms

Absence of ovulation
An anovulatory cycle is a menstrual cycle during which the ovaries do not release an oocyte.
Learn more at: www.fertilitypedia.org/edu/symptoms/absence-of-ovulation

Infertility
The failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse.
Learn more at: www.fertilitypedia.org/edu/symptoms/infertility

Irregular menstruation
Irregular menstruation is a menstrual disorder whose manifestations include irregular cycle lengths as well as metrorrhagia.
Learn more at: www.fertilitypedia.org/edu/symptoms/irregular-menstruation

Menarche
The age at onset of first menstruation.
Learn more at: www.fertilitypedia.org/edu/symptoms/menarche

Sources

Pic
List of the hormones found in the endocrine glands on the nervous system.

Pic
The hypothalamus is a structure of the diencephalon of the brain located anterior and inferior to the thalamus.